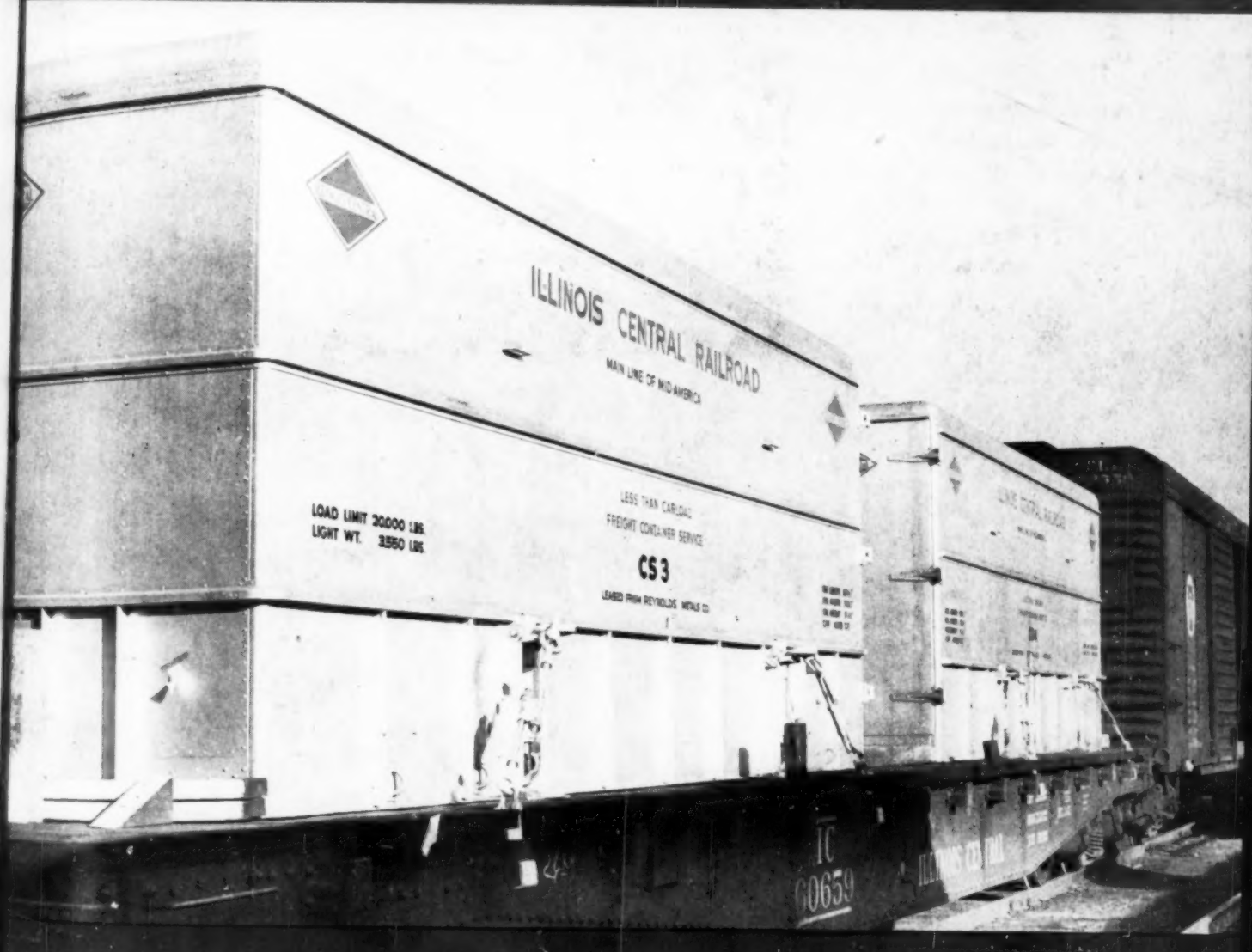
APRIL, 1948

Applied HYDRAULICS

The Magazine of Hydraulic and Air Circuit Engineering



FUNDAMENTAL PNEUMATIC CONTROL CIRCUITS, PAGE 11
OUTLAW OIL -- WHAT A PLANT DID ABOUT IT, PAGE 20

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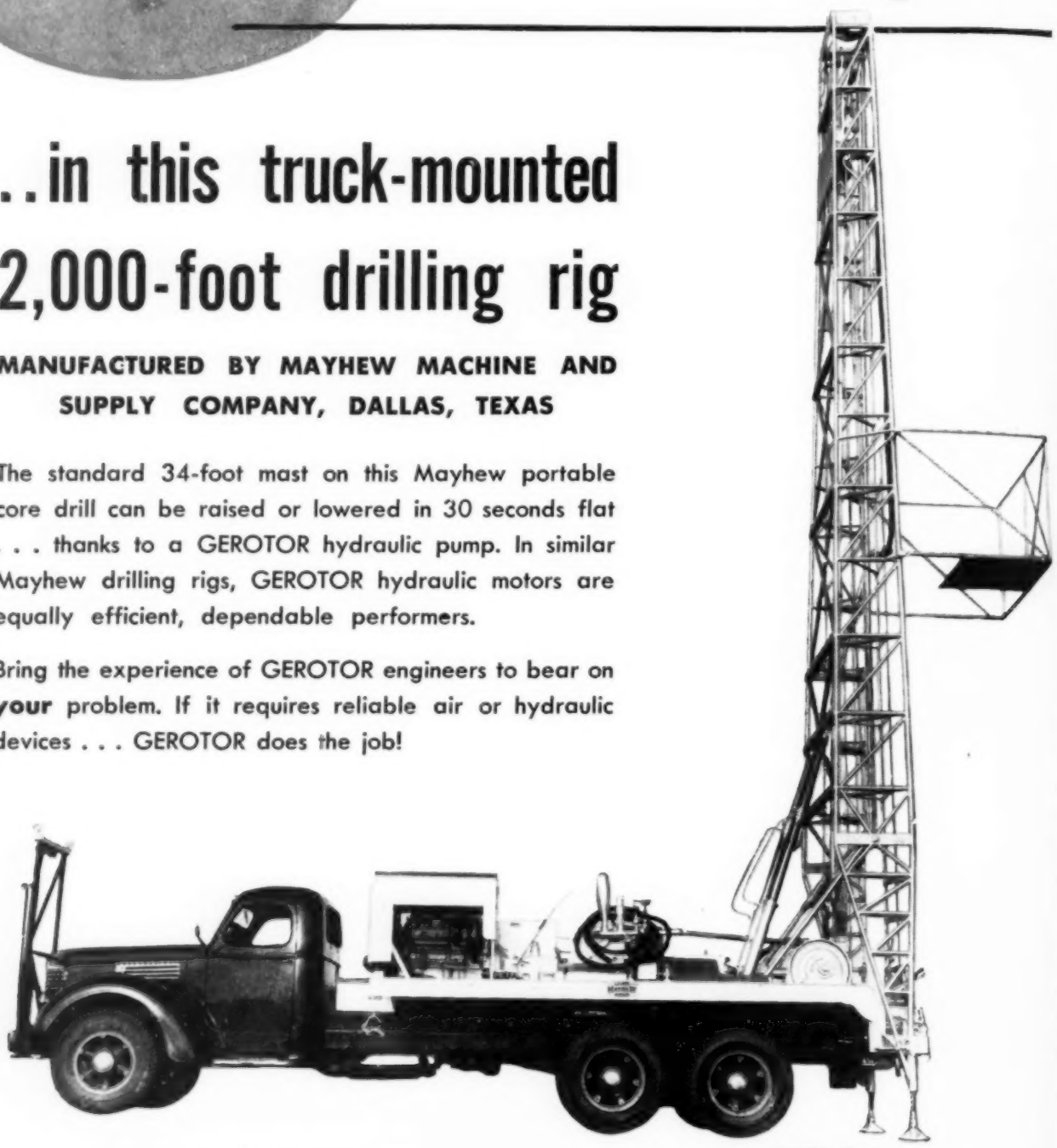

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APRIL, 1948

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Applied HYDRAULICS

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FRONT COVER: The containers shown, especially designed to cut LCL railway freight shipment costs, are handled entirely by hydraulic equipment. This equipment is mounted on standard truck chassis and trailer units. Story on page 7.

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The design and construction of a fully hydraulic thread and form rolling machine

HYDRAULICS TURNS YOUE

Fig. 1. Front view of the three-roll hydraulic thread and form rolling machine. Pressure (left) and speed (right) control valves are conveniently located just below the coolant ledge; the motor start and stop and automatic - manual controls are at the right of the head; precision setting of the work roll depth is done by the micrometer hand wheel (top right).

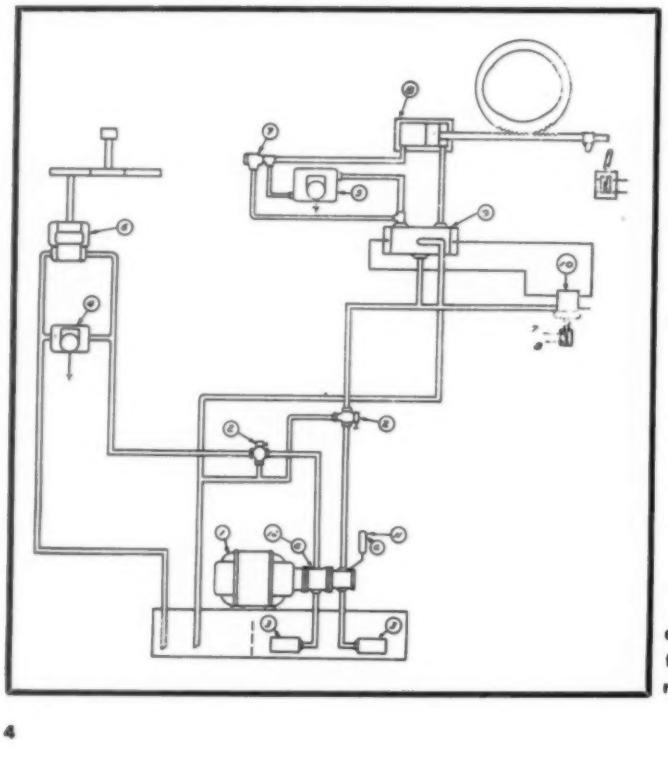


Fig. 2. Hydraulic circuits in the thread and form rolling machine.

One of the first fully hydraulic thread and form rolling machines is described. The simplicity, compactness and adaptability of the machine are in a large measure due to the utilization of hydraulic elements.

THREAD ROLLING machines are relatively new as a standard machine tool and in most cases still retain some of the design characteristics of special machines. By this we mean the machines are large and heavy; often they are more complicated in design and in their operation. From the practical point of view this means high initial cost, special training for setup men and operators and headaches for the maintenance men.

The success that our chucking automatics has enjoyed with hydraulic actuation convinced us that hydraulic operation should be designed into the new standard thread and form rolling machine. Thread rolling as a process for both first and second operation work is making rapid strides in the precision metal working industries and our sales and engineering estimates agreed that a standard thread rolling machine has a definite place in the modern manufacturing plant.

One of the first standard thread rolling machines to be designed expressly for full hydraulic operation was able to

OUEAD

By ARTHUR C. CORDRAY
Design Engineer
The National Acme Co.
Cleveland, Ohio

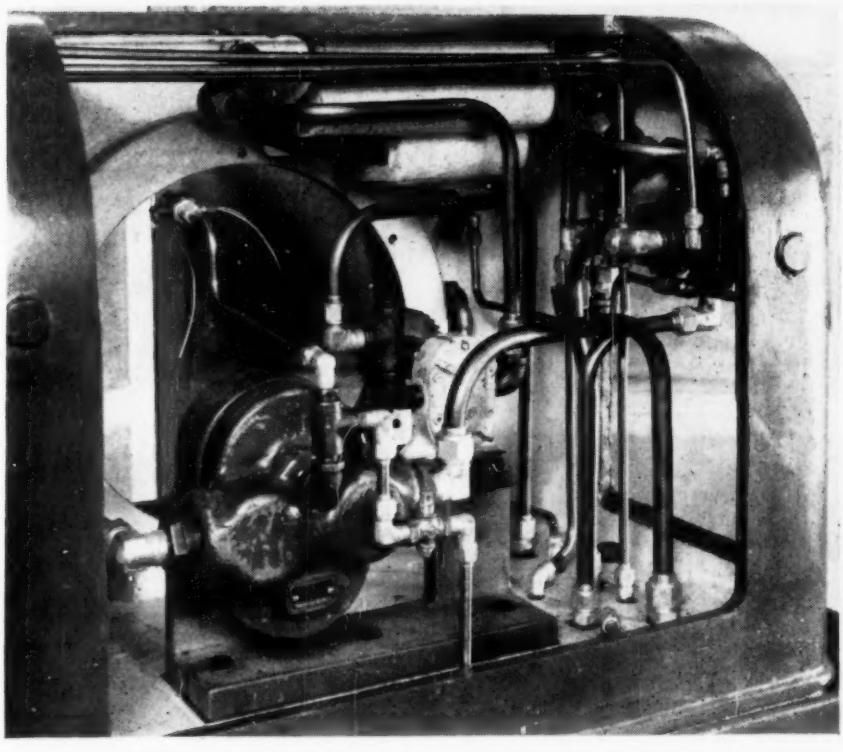


Fig. 3. The upper rear of the machine with the working head and the back panel removed. Spindle drive fluid motor, coolant pump, pilot operated 4-way valve which controls the piston stroke, and check valve for by-passing the feed valve on rapid cam return are shown.

take advantage of the natural adaptability of hydraulic cycling to the basic approach-feed-retract requirement; the simplicity, high, even flow of power, and ease of maintenance characteristic of hydraulic systems were utilized to their best advantage.

Advantages that were desirable and that were essential in the design of our standard thread rolling machine included: (1) simplicity and strength; (2) easy interchangeability of working heads; (3) ability to work to high precision; (4) accessibility for adjustment and maintenance; and (5) low cost in terms of production capabilities. Other factors also considered were overall machine dimensions, ease of operation and control and safety factors to eliminate human errors.

The Working Head

The basic element in the machine is the working head. The head is mounted in a heavy frame housing; the outer face of the head is a one-piece cam ring. Oscillation of the head moves the roll-guide slides, which are kept in contact with the cam ring by spring plungers, into and away from the work. One set of anti-friction rollers back-support the cam ring; another set supports the roll-guide slides. A third set of anti-friction rolls, located on the spindle ends, have non-revolving races which bear on the guide holders and inner races studded to the work roll spindles.

This simple, straight-line support for power applied directly from the cam to the work, eliminates any need for linkages and gives the ruggedness to make heavy feeds in fast cycles with high precision and uniformity.

The entire head may be removed through the front of the machine, easily and quickly. Three standard 3-roll heads cover a work range of $\frac{3}{8}$ in to $1\frac{1}{2}$ in diameter. Three-roll heads are used for heavier work in the harder materials and for hollow work on thin walled stock where the contact of three

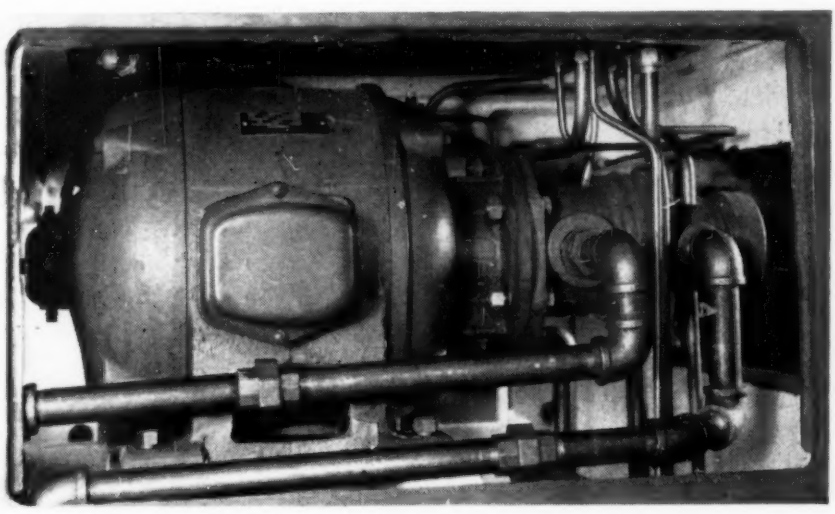


Fig. 4. The 10 hp motor, the 18 gpm pump for pressure on the work spindles (next to motor) and the 8 gpm pump for operating the cylinder. The motor and pumps are mounted directly below the equipment shown in Fig. 3.

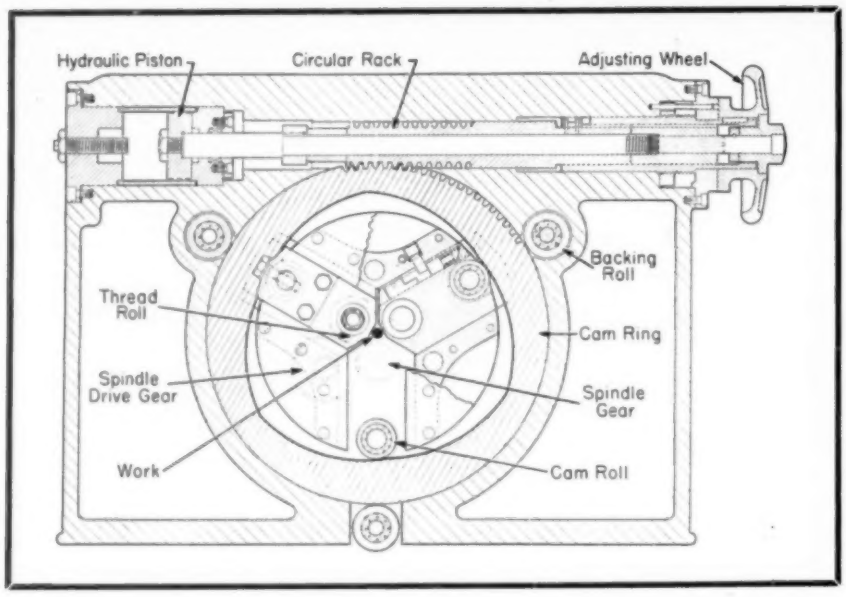


Fig. 5. The simplicity of the adjustment of the position of the roll slides by oscillation of the cam ring is shown. Work spindles are driven by the spindle fluid motor through a drive gear; the micrometer adjusting wheel sets the penetrating depth of the work rolls.

rolls is required to compensate pressures and avoid out-of-round distortions. Two roll heads are provided for stock sizes from the smallest diameter to 9/16 in.

Each head is a complete assembly and can be changed to any other in less than 30 minutes with no other machine alteration.

An average production rate of 900 small pieces per hour is easily achieved.

The Hydraulic System

The hydraulic system, in line with the general machine design, is a model of simplicity. A single 10 hp motor drives the two pumps in tandem, the larger 18 gpm pump for pressure on the work spindles, the smaller 8 gpm pump for operating the piston controlled rack which oscillates the cam ring and times the cycle.

The fluid motor in the 18 gpm circuit (6, in the hydraulic diagram) drives the work spindles through one center spindle drive gear and gear reductions. A relief valve (2) and a flow control valve (4) complete the spindle circuit. Flow control valve (4) is a bleed-off type valve. As the amount of oil that is being pumped to the fluid motor determines its speed the flow control valve by bleeding off more oil reduces the speed of the fluid motor and conversely increases the fluid motor speed by bleeding off less oil. The rate at which pressure is exerted on the rolls is regulated by adjustment of the flow control valve. This valve with its gage is conveniently located on the left front of the machine. Selective speeds are controlled by a variable fluid motor control valve on the right front of the machine.

A 4-way pilot operated valve (9) in the 8 gpm fluid motor circuit operates cylinder (8) which oscillates the cam ring by means of a circular rack. The length of the piston stroke is controlled by a stop screw at the top left of the machine. Flow control valve (5) is a meter-in type valve for oil supply to the cylinder (8). Solenoid operated pilot valve (10) controls the machine cycling. Switch (13) at the end of the piston functions as a time delay at the end of a cycle.

A coolant pump is gear driven off the spindle fluid motor. Because of the nature of the work done (threads or serrations are form pressed, there is no removal by cutting) it is customary to use the hydraulic oil for lubrication. Two reservoirs are provided, one for hydraulic oil, one for coolant. In operations that require a heavy flow of coolant (extra heavy or coarse threads or feed-through types of work), an auxiliary coolant tank is provided.

The machine is normally equipped with a hand loader for work of short length. For long stock, a roll fixture, which supports the stock at both ends, is used. The stock is pushed

(Continued on page 8)

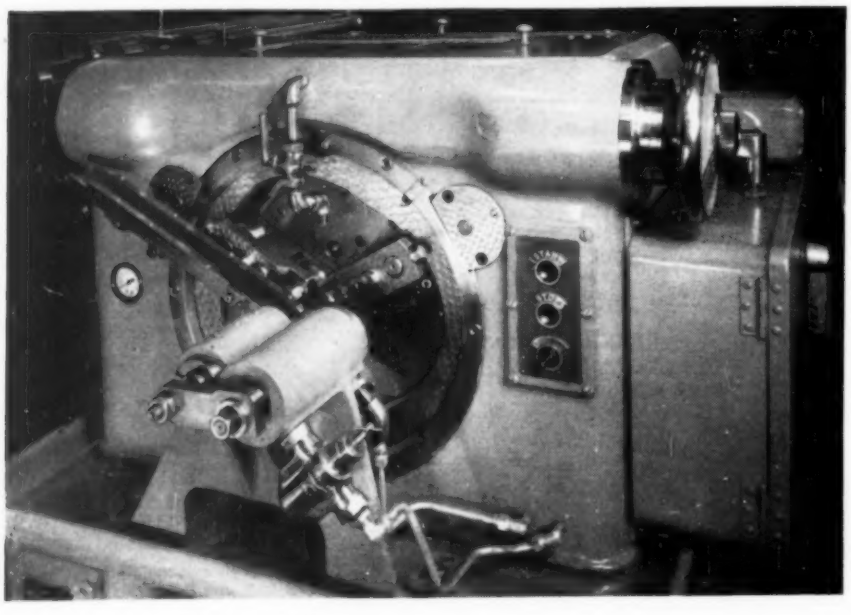


Fig. 6. A hydraulic feeder, as shown, can be used for increasing production of some classes of work. This feeder, installed to roll 9/16 in-20 SAE 3140 steel studs, made a production rate of 50 per minute possible. The actuating cylinder is at the right.

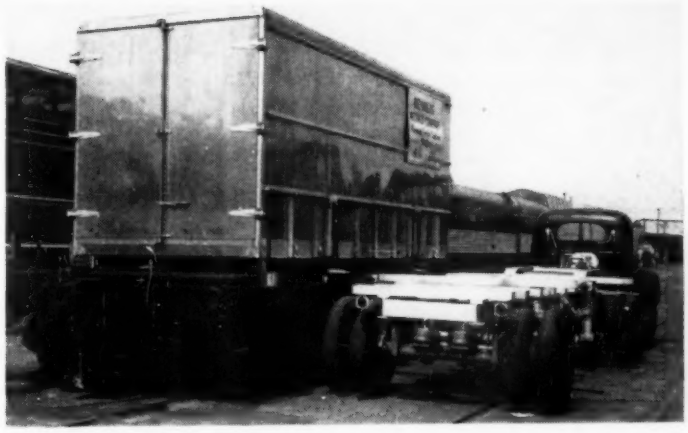


Fig. 1. The Trailerail unit loaded on a flat car ready for transit.

LCL... HYDRAULIC DELIVERY!

A new equipment setup for the handling of LCL freight; the operation of two hydraulic systems supplies the power requirements for all the necessary handling. The advantages of low cost, speedier deliveries and elimination of handling damage loss have been substantial.

Fig. 2. The container is tilted toward its loading car by elevating one set of rams.

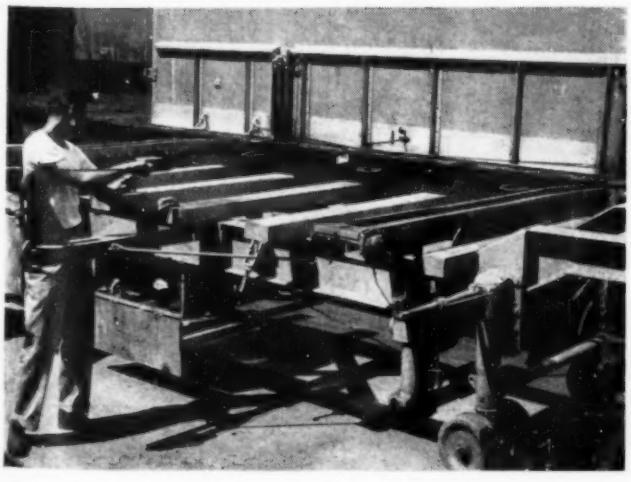


Fig. 3. The cable hookup in place preparatory to loading the container onto the trailer.

A NEW technique in handling LCL freight by hydraulic means has been instituted by the Illinois Central Railroad through the development of a special "Trailerail" unit by the Reynolds Metals Company.

Experimental runs between Chicago and Memphis, Memphis and Louisville and Louisville and Birmingham have demonstrated the feasibility of making freight deliveries between these cities the next business day after their pickup at the point of origin.

A study of LCL operations and costs made by a group of eastern railways for the year 1946 indicates that a greater part of the terminal expense and nearly 50 percent of the line-haul expense are incurred by handling the freight across platforms at freight houses and transfer points. In addition a large part of the loss and damage to LCL freight was found due to platform handling.

The Trailerail unit is actually a detachable trailer body of approximately half a standard box car in load capacity (20 x 8 x 8 ft for loads up to 20,000 lb). The entire unit is of aluminum construction — framing members, rub rails and exterior surface, solid riveted throughout. This unit is used in conjunction with

a specially equipped tractor and trailer. The operation, as described below, has greatly reduced the terminal expense, resulted in much faster deliveries and actually makes door-to-door freight deliveries practical at a new low in cost.

There are two hydraulic systems incorporated in the equipment. One of these, a 5000 psi, manually operated set of rams and pumps, is a part of the container unit; the other is a 1000 psi 4-way valve operated set of rams and pumps built into the trailer unit. The power take-off is mounted on the tractor and the same pump supplies the fluid motor which drives a cable winch.

The Trailerail unit or container is transferred as a package, eliminating separate handling of freight at both receiving and destination platforms. As shown in Figures 3 and 4, the high pressure rams and pumps are built into the outside walls of the container. Wheels are mounted on the ends of the rams so that when the rams are in their extended position, the container is raised onto the wheels. The entire container is simply rolled or winched from the trailer onto the flat car or vice versa.

The tractor unit is a standard International K-7 chassis and cab; the trailer unit is equipped with four hydraulic rams and cylinders, which are installed to raise and lower two flanged rails on which the wheels of the container run in loading and unloading.

To load or to transfer the container from the trailer to the flat car, the trailer is run along side and parallel to the flat car. The operator cuts in the power take-off and operates the ram control valves (Figure 4) to raise the container to the level of the flat car platform. The 4-way control valves, one for each ram and cylinder, are mounted in a bank as a multiple unit.

When the trailer rams have raised the container to the level of the flat car platform, the manually controlled pumps built into the side walls of the container are actuated to lift the container up onto its wheels. At this point the trailer rams on the side away from the flat car can be opened further to tilt the container slightly (Figure 2). The container can then be rolled onto the flat car. The winch can be used to pull the container onto the flat car by means of a cable.

The rams in the container are then retracted, lowering the body of the container flush to the platform. The container is then securely locked in position by heavy duty turnbuckles and anchor blocks.

At the destination the unloading procedure is simply the reverse of the loading. The container is unblocked and the turnbuckles removed; the container is raised onto its wheels and the trailer body, brought along side, is raised to the level of the flat car platform.

The winch is actuated and the cable is run through the draft rings at the base of the container. The winch then pulls the container onto the trailer body. The container wheels are retracted and the trailer rams are retracted and the cable disconnected. The operation can be handled by one man in a few minutes time.

While the Trailerail method of handling LCL freight is still considered experimental, the advantages of lower cost, faster deliveries and elimination of handling damage loss, for railroad and shipper alike, are substantial. The LCL rail shipper may soon be able to specify "Hydraulic Delivery."

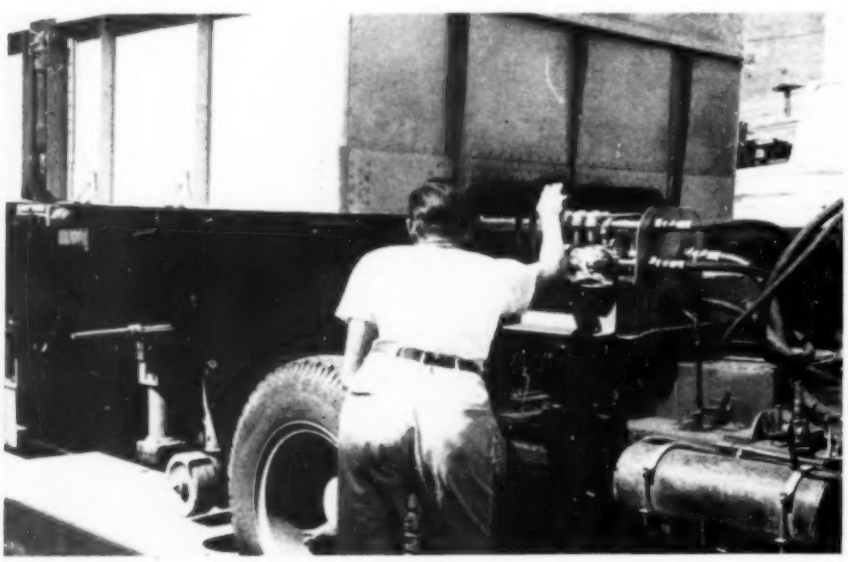


Fig. 4. Driver operating ram control valves in loading.

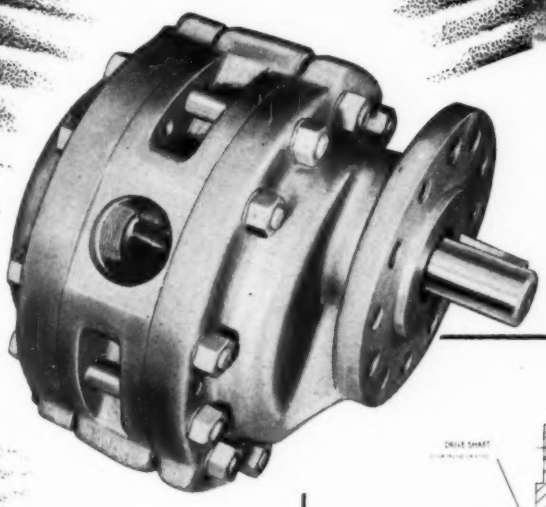
HYDRAULICS TURNS YOUR HEAD

(Continued from page 6)

against a stop. A selector switch prevents the foot switch from starting the cycle until a hand locking clamp is closed by the operator.

For full automatic operation a hydraulic feed, controlled by an electric timer located in the control box can be used. Automatic operation can be used with a magazine type loader and front ejection of work or with feed-through with rear ejection.

The trend toward higher speeds and automatic cycling in machine tools has given designers of many types of machine tools an opportunity to utilize the inherent advantages of hydraulic power and control. This is true for such production machines as described where simplicity, compactness of design, adaptability, high production at precision limits and the control of multiple circuits and the sequence of operations are basic requirements.



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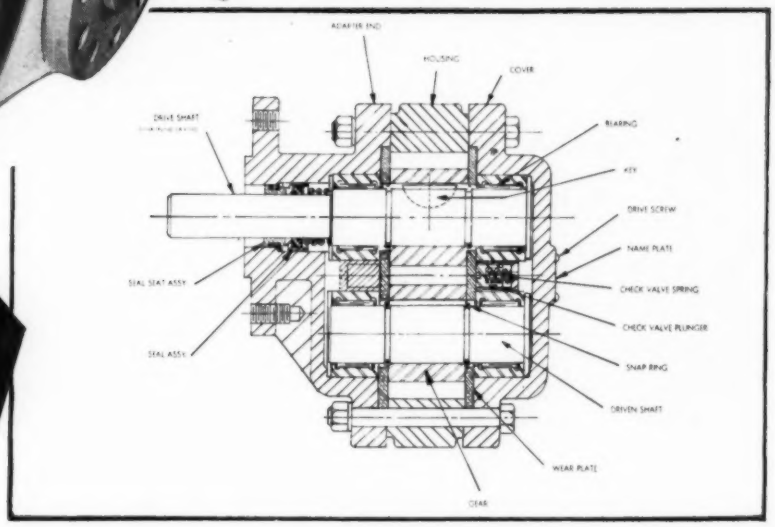

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FUNDAMENTAL PNEUMATIC CONTROL CIRCUITS

The fundamentals of design and operation of three of the common types of pneumatic controllers. While primarily designed for process control work, pneumatic controllers have steadily increasing numbers of applications throughout industry.

By V. V. TIVY
The Foxboro Company
Foxboro, Mass.

AUTOMATIC CONTROL is playing an ever-increasing part throughout industry, and as process difficulties increase so do those of the control engineer. There are many daily users of automatic controllers who have only a hazy notion of how they operate, principally because their work lies in other lines and the controllers are purely incidental to their main job. A working knowledge of the theory and practice lying behind automatic control would be a considerable help to these men as well as to those responsible for the maintenance of controllers. It is our purpose here to present briefly, and in simple terms, the theory of the modern pneumatic controller, together with the means by which this theory is translated into practice.

First, it may be well to define the purpose of a controller and what we mean by a controller. The pneumatic controller is a device furnished with a measuring element capable of detecting changes in the variable to be controlled which translates these changes into movements of a valve capable of influencing the controlled variable.

There are three types of pneumatic controllers in common use. The first type is the simplest and the type originally developed. This is the on-off controller.

In this type of controller, Figure 1, cycling is continuous when the unit is in operation; otherwise the valve would remain at either the open or the closed position. When applied to processes suited to this type of control the amplitudes of the cycles are so small that record may be considered a straight line, and this type of control is, therefore, satisfactory. There are many such applications such as the temperature control of a large mass by the periodic admission or removal of heat. A very common illustration of this type of control is the room thermostat, which measures the temperature in the room and, if the measurement is low, turns on the heating plant and keeps it running or open until the measurement has reached the control point. At this point the heating plant is shut off or closed. When the measurement again drops below the control point, the cycle repeats.

The on-off controller has another valuable application when used to give an alarm signal or to operate safety equipment in emergencies, or where it is desired to cut in equipment at certain points in a widely changing measurement. On-off controllers can be utilized to introduce a second meter, where orifice meters are being used, when the range becomes too high for the original meter. Orifice meters are widely used to measure the rate of flow of gas.

In the discussion which follows on the motions and changes in output pressure of a controller, it will be assumed that the output pressure of the controller is at all times within the limits of 0 to 17 lbs. It is always possible to move the measurement so much that the air pressure reaches one of these limits. However, this means the controller has gone out of its working range and the relations between air pressure and measurement motion which have been established need no longer remain as stated.

On-Off Controller

Figure 1 shows the arrangement of an on-off controller schematically, with the essential

linkages between the measuring element, control relay and control setting knob. A differential linkage between the pen-arm and index pointer is so arranged that any motion of the pen relative to the index pointer results in a motion of the flapper; when the pen-arm and index pointer are together, the linkage is arranged so that the flapper is just tangent to the nozzle. Operation of the relay is easily followed. Supply air enters at the top, passes through a reducing tube to the relay bellows and out through the nozzle. When the nozzle is uncovered, air from the reducing tube escapes to atmosphere and the pressure in the relay bellows is sufficiently low to collapse the bellows. This closes off the air supply to the control valve and vents air from the valve to atmosphere. As the flapper moves toward the nozzle the pressure in the relay bellows builds up, pushes the stem upwards, closes the exhaust from the control valve and opens the air supply to the valve. When the bellows pressure has built up sufficiently, the exhaust valve is completely closed and the 17 lbs supply pressure is going directly to the valve.

A very small motion of the flapper toward or away from the nozzle is sufficient to change the pressure in the relay bellows and throw the relay valve from one extreme to the other, changing the output pressure from 0 to 17 lbs. This small motion may be translated into a useful figure by referring to the motion of the measuring element, as registered by the pen on the chart or indicating scale of the controller. A motion of the pen corresponding to one-fifth of one percent of the total scale range of the instrument is sufficient to move the flapper an amount which will throw the relay from one extreme to another; when the flapper nozzle relationship is set so that this throw of the relay will take place when the pen crosses the control point, the control system is properly lined up.

It is clear that a small motion of the pen-arm across the control index will operate the control valve from one limit to the other and that the point at which this action occurs may be selected by moving the control index to any desired point on the scale. Examination of the linkage indicates that the action of the instrument may be reversed by moving the flapper link from one end of the reversing bell crank to the other. This makes it possible to arrange that the air pressure to the valve will be increased or decreased as the pen-arm moves up or down.

Proportional Controller

The second commonly used type is the proportional controller. It is so-called because the valve, instead of moving intermittently as in the on-off controller, continues to move as long as the measurement moves, assuming that the valve does not reach the limit of its stroke. The measurement moves at a constant rate. At any time the amount of valve movement is directly proportional to the amount of measurement movement, and it is in a direction to oppose the motion of the measurement. The valve position always bears a fixed relation to the measurement and the peak valve motion occurs at the point of greatest measurement deviation.

In the conventional proportional type controller it is possible to vary the amount the valve will be moved by a given measurement change by adjusting the proportional band of the

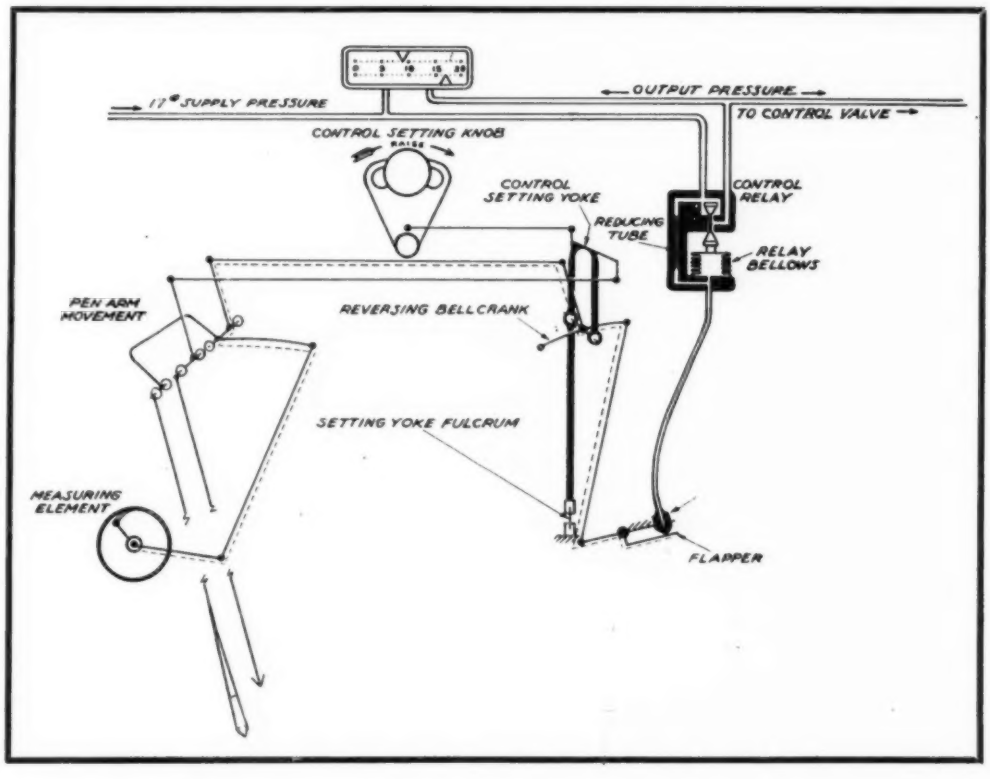


Fig. 1. The on-off controller.

instrument. The proportional band is defined as the percentage of the scale through which the measurement must move in order to produce a travel of the valve from one extreme to the other. For example, a 100 percent proportional band controller is one in which a 100 percent scale movement of the measurement is required to give 100 percent valve movement.

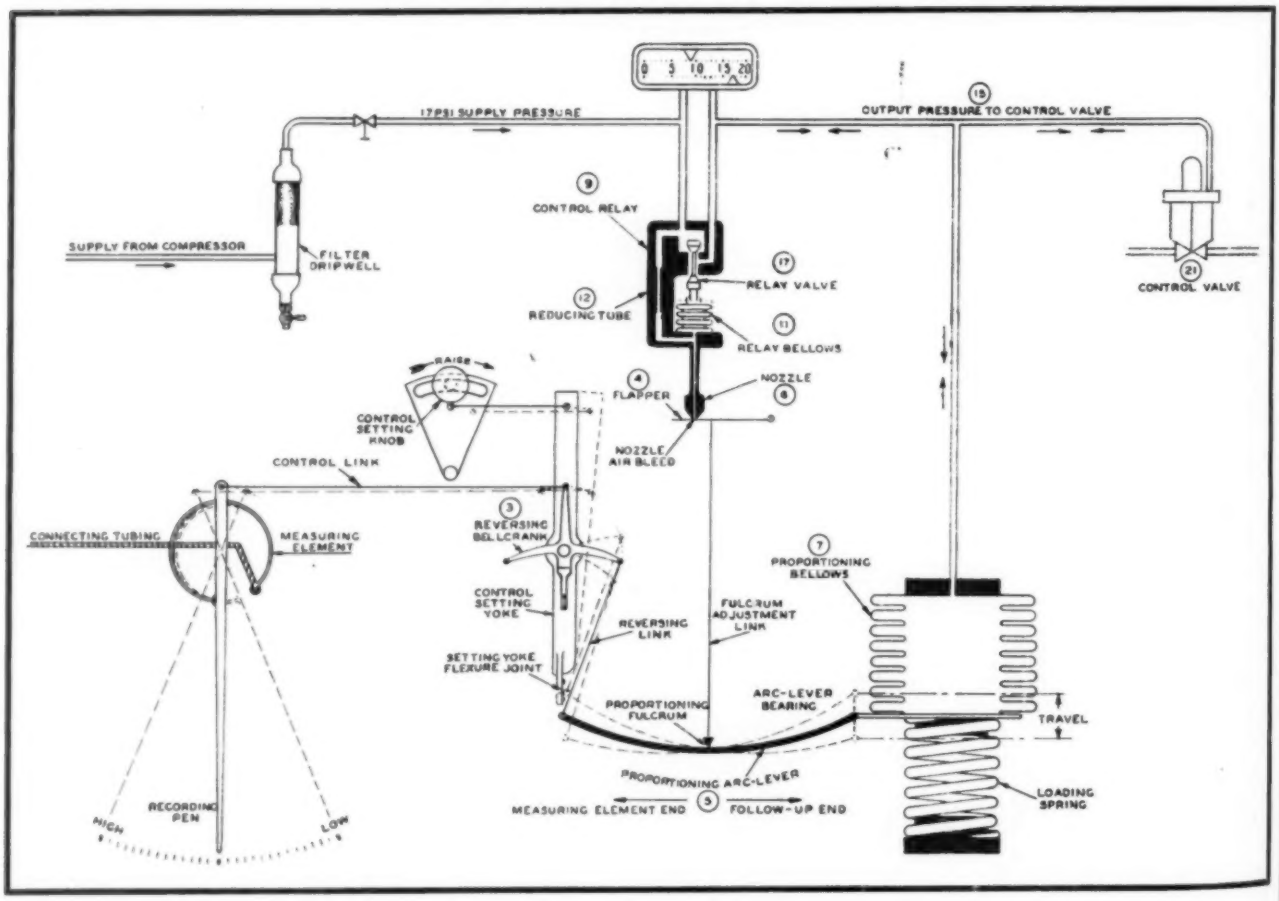
With a proportional controller each valve position is related to a definite position of the measurement. The controller may be adjusted so that the valve is positioned to bring the measurement to the desired value. However, the measurement will be maintained at this point only as long as there is no change in load or other variables. If, for example, the pressure drop across the valve changes, then it must assume a new position which is necessarily away from the control point. This drift from the control point with load or condition change is defined as "off-set". Off-sets, may or may not be objectionable, depending on their magnitude and on the process requirements. It is obvious that when the proportional band of the controller is narrow, the off-set on normal changes in load will be small; when the proportional band is wide the off-set becomes correspondingly larger.

Figure 2 is a schematic diagram of a proportional controller. This controller does not vary from the on-off controller in its essentials. Fundamentally, the only change is the addition of the proportioning bellows and loading spring, with the flapper link taken from the proportioning arc lever rather than direct from the reversing bell crank. Tracing the circuit through, it may be seen that if the pressure in the proportional bellows were to remain constant the action of the controller would be exactly the same as that of an on-off controller.

However, when the air pressure from the relay is allowed to enter the bellows there is a resultant motion of the flapper in the direction opposite that caused by the motion of the measuring element. If we consider this system starting with 0 pounds in the proportional bellows and the flapper away from the nozzle, we can follow changes in the measurement positions and see what happens to the controller. Assume the measuring element is moving in a counterclockwise direction, gradually pushing the flapper toward the nozzle. As soon as the flapper reaches a point close to the nozzle it begins to build up pressure in the relay bellows, causing the output pressure to increase and, in turn, expanding the proportioning bellows, tending to move the flapper away from the nozzle. If the pressure in the bellows increases too much the flapper will be moved so far from the nozzle that it will reduce the pressure and restore the flapper to the nozzle.

As long as the measuring element operates within the pro-

Fig. 2. The proportional controller.



portional band the relay will be positioned so that there is just sufficient pressure in the pro-

As may be observed by inspection of the linkage system in Figure 2, the width of the pro-

the controller are such that the maximum off-set is within the permissible variations of the

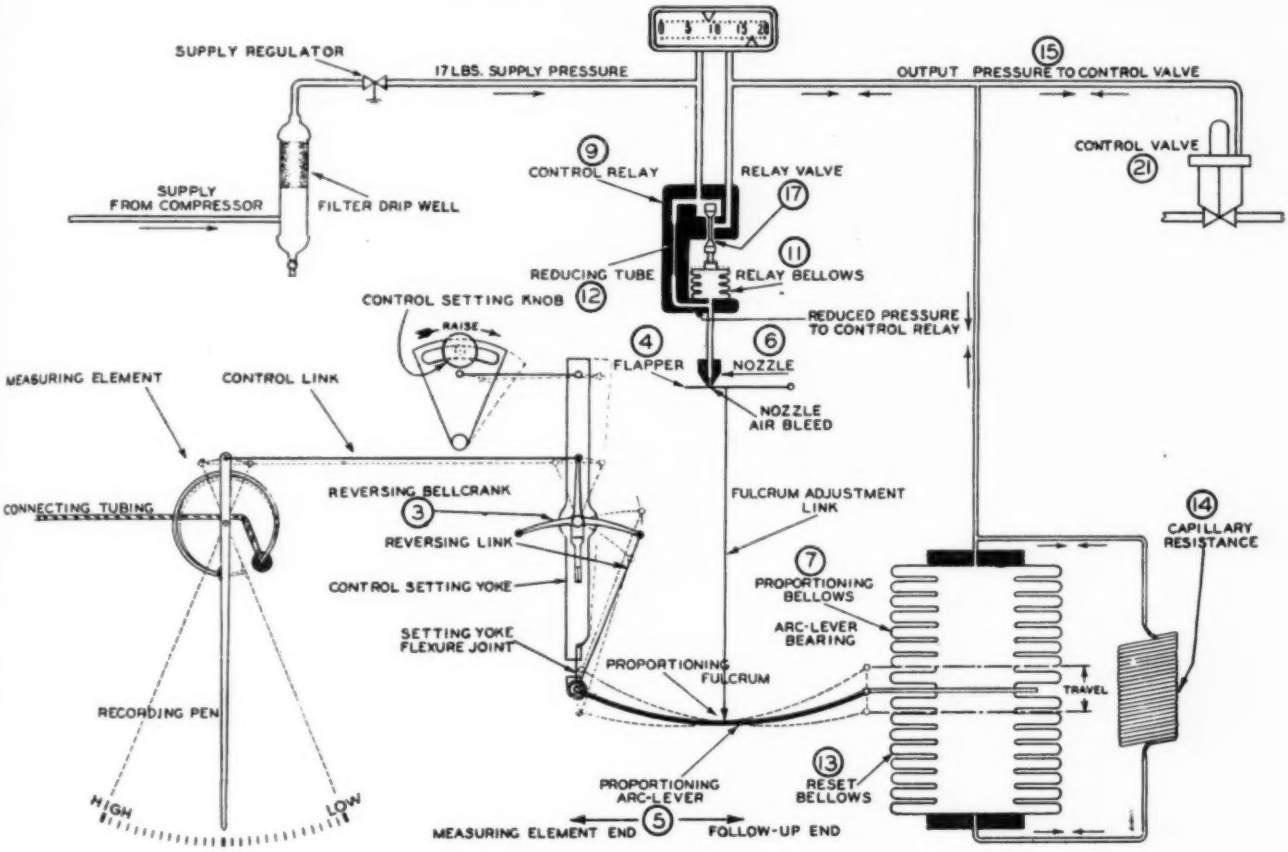


Fig. 3. The proportional and reset controller.

portional bellows to maintain the flapper tangent to the nozzle. Because of the simple linkage the position of the bellows end of the proportioning arc lever must be exactly proportional to the position of the measuring element if the flapper is to remain in the same location, and since the position of the moving end of the proportional bellows is directly proportional to the pressure in the bellows, this pressure must be proportional to the position of the measuring element.

When the controller reaches the point at which the pressure in the proportioning bellows is at the limit either of 0 or 17 lbs, any further movement of the measuring element will carry the flapper either away from the nozzle or directly onto the nozzle where a continuing motion of the element is taken up on a hair spring overload system. The controller is said to be beyond its proportional band.

portioning band may be changed by moving the fulcrum adjustment link between the flapper and the arc lever along the length of the arc lever. When the link is moved towards the proportioning bellows, a larger motion of the measuring element is required to move the flapper a given amount, and a correspondingly smaller movement of the proportioning bellows to give an equivalent follow-up action. The net result is that a larger motion of the measuring element will result in a smaller change in output air pressure. Stated more simply, the proportional band becomes wider. Conversely, when the link is moved away from the proportioning bellows, a smaller motion of the measuring element will require a larger change in output pressure to give the same follow-up. In this case, the proportional band becomes narrower.

Where operating conditions and the proportional band of

controlled medium, the proportional controller is satisfactory. When this condition is not satisfied it becomes necessary to add a second function to the controller to overcome these objections. This function has been loosely termed "reset". A more precise definition of reset is given by ASME which lists two types: (1) constant speed floating; and (2) proportional speed floating. The constant speed floating controller is one which moves the valve at a *fixed rate* in a direction to correct for the measurement deviation. The valve moves at this rate regardless of the amount of deviation and will continue to do so until the measurement is returned to the control point. This is typical of the operation of electric rate controllers. The more common conventional air-operated proportional and reset controller, on the other hand, employs the proportional speed floating ac-

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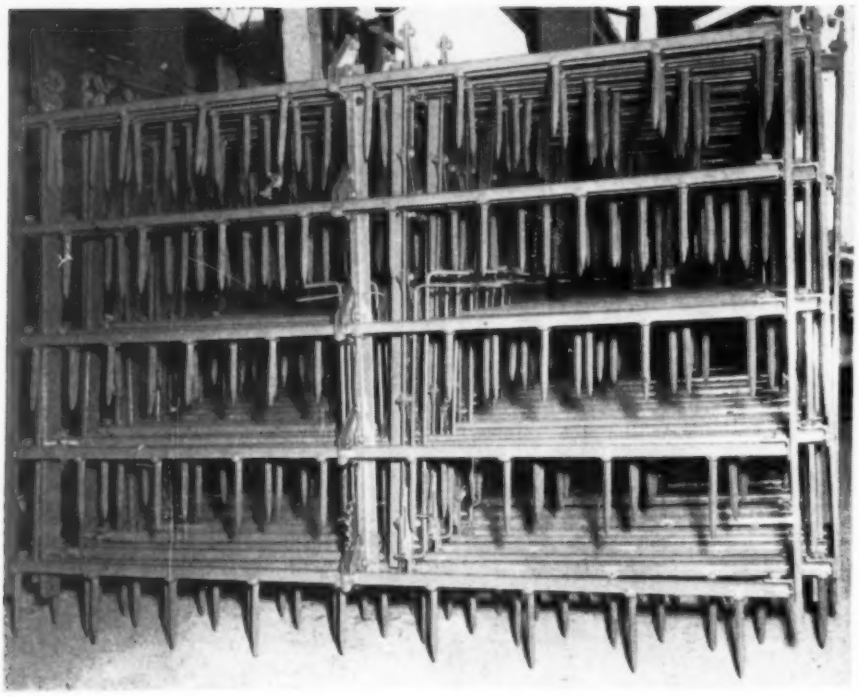

Fig. 1. Complete assemblies of harrows. Since the teeth are welded to the frames the entire operation is a combination of conventional and "reversed" welding.

An unconventional use of a resistance welding machine equipped with air clamping and locating cylinders to form harrow tooth profiles.

MAKING A POINT . . . BY PULLING TEETH

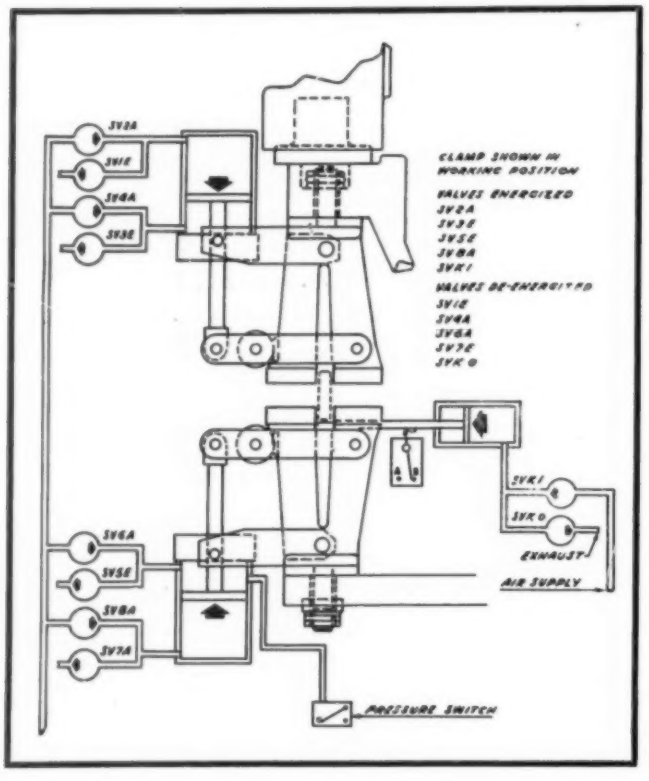

Fig. 2. Schematic arrangement of air clamping cylinders.

By DAVID SCIAKY
Chief Engineer
Sciaky Bros. Co.
Chicago, Ill.

BY REVERSING the conventional pressure system in a spot welding machine and equipping the machine with clamping devices, the Kewanee Machinery and Conveyor Co. of Kewanee, Illinois, is pulling harrow teeth by passing a high amperage current through a bar that is stretched and broken to form a finished contour. Pneumatic clamping is utilized to hold the bar in the heating and stretching cycle.

The secret of the success in the forming of a tapered profile is in the setting of the secondary

current. After considerable cut-and-try, it was determined that by interrupting the secondary current just prior to the breaking of the bar, arcing between the ends of the bar points could be eliminated. Such arcing, of course, would have ruined the pointed shape of the bar ends.

Sequence of Operation

The sequence was arranged so that the bar would heat to the desired temperature, after which the welding cylinder would begin to move the clamped ends of the bar apart until it breaks. By adjustment of the secondary current, time and the pulling force, a tapered profile, accurate well within the dimensional requirements of the finished harrow teeth, could be formed.

In the first set up of the machine a hydraulically operated clamping fixture was used. The clamp was not automatic and required both time and effort to operate it. Since there was ample room for larger clamping cylinders, the hydraulic mechanism was readily changed to air clamping. After test runs, the pneumatic clamping proved to be more advantageous for this particular job. The pneumatic clamping also reduced the initial cost of the machine.

The processing of pointed bars for harrow teeth had been a slow, expensive job. At Kewanee Machinery and Conveyor Co., like in plants of other manufacturers of cultivating equipment, the process involved forged bars and the services of a skilled power hammer operator and a helper to form the harrow tooth profile. Working conditions necessarily were bad and few workers are able or willing to try it. Furthermore, it was difficult to get uniform profiles by this method.

The use of the new technique has completely changed this picture and an unskilled man can turn out more and better work than a skilled man could by the old method.

With the resistance welding method the first advantage was the ability to use reclaimed rail steel of high carbon content in place of the forged bars. Old rail stock was re-rolled and there was no analysis control. The stock carbon and manganese content was variable and generally on the high side. The second advantage was the uniformity of the tooth profile produced. The length of the teeth was not critical since the length did not materially affect their efficient operation. However, from an appearance standpoint, they should appear to be all the same length. The third advantage was a greatly increased rate of production.

After the pulling operation the points are quenched in oil. Quenching imparts the neces-

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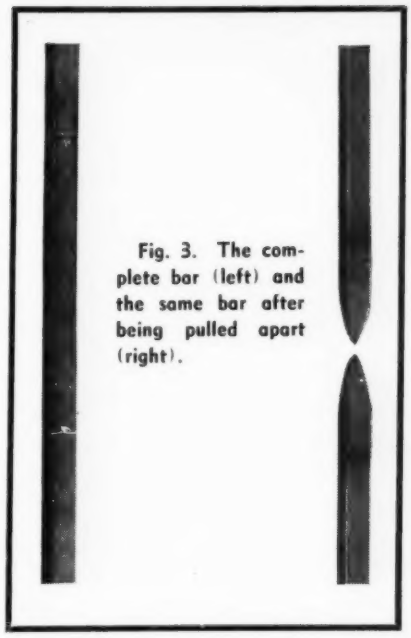


Fig. 3. The complete bar (left) and the same bar after being pulled apart (right).

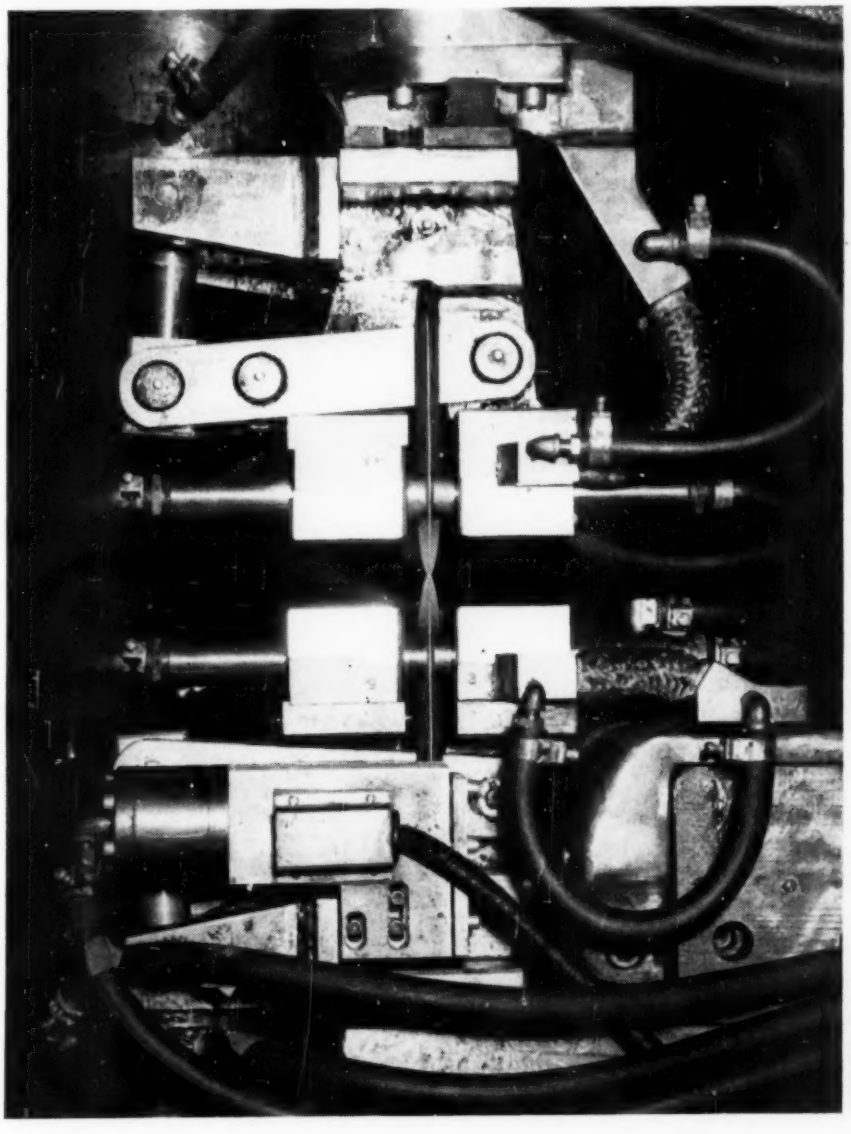


Fig. 4. After the bar is heated, the head cylinder retracts to pull the bar into two finished harrow teeth.

OUTLAW OIL . . . .
WHAT A PLANT

By JOHN W. FAUVER
Application Engineer
J. N. Fauver Co., Inc.
Detroit, Mich.

THE MOST EXPENSIVE hydraulic fluid is that on the shop floor. You don't have to argue with production men in Chrysler Corporation's Jefferson Avenue plant in Detroit to get a full endorsement of that statement.

Hydraulic fluid on the floor constitutes expensive evidence of a faulty hydraulic system. A leaky system means loss of power, loss of power in turn means a production drop. It is a danger signal of loss in system efficiency and represents a threat of complete failure, leading to costly machine downtime.

Hydraulic oil on the floor involves more than the cost of the fluid wasted. From a safety point of view, it is a definite hazard to plant personnel. In addition, to maintain the good housekeeping standard of this company the floor either had to be steamed or be subjected to other costly cleaning processes —with accompanying inconvenience and likely interruption of production.

During the war, under the tremendous demands for military production, keeping machines running proved to be a strenuous and sometimes desperate undertaking in face of the loss of skilled manpower and the difficulties of obtaining essential replacement parts. In many plants, existing circumstances made it practically impossible to provide the proper kind of maintenance.

Certainly, machine tool hydraulic systems suffered. Maintenance crews rushed from one emergency leak to another. In

Fig. 1. The piping arrangement on a crankshaft machine before the changeover. A total of 120 pipe joints were in the system.

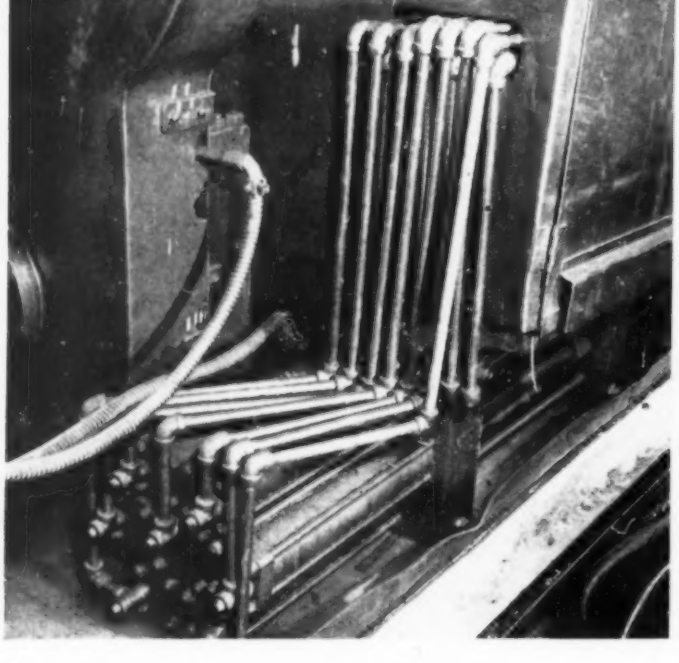
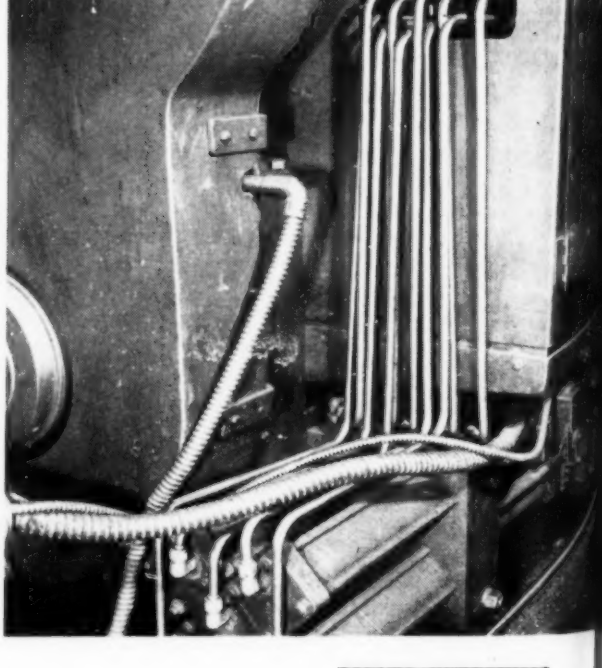


Fig. 2. A machine identical to that shown in Fig. 1 after the changeover. A total of only 20 tubing connections were necessary.



ABOUT IT

Starting with a problem of excessive oil leakage, a large automotive engine plant is systematically "revitalizing" their hydraulically actuated production machine circuits to "outlaw" oil waste, maintain designed system pressures and machine efficiencies, and to simplify systematic maintenance.

many cases, stocks of maintenance parts were woefully short and once used up, were irreplaceable. The repairman had to get his job done as best he could with whatever happened to be available. Some curious "patchwork" resulted. As a "hangover" of those frenzied war production days, many of these patchwork circuits—all kinds of pipe and tubing joined by all kinds of fittings—are still leaking away today to plague the disposition of production men and swell the costs of operating production machinery.

The implications of such conditions, multiplied in plant after plant, have been particularly serious because they have given hydraulics a "black-eye" which it by no means deserves.

A hydraulic system is no better than the physical circuit which connects the various elements. From the point of view of management, leaky systems and hydraulic failures may cause production losses which more than offset the inherent advantages which hydraulics has to offer. For this reason many production manufacturers have been definitely cool to hydraulically operated equipment because of the compounded difficulties resulting from wartime patchworking.

The remedy for this situation is obvious; bastard lines should be eliminated completely and replaced with uniform elements specifically designed for long-life hydraulic service. Such renovation, followed up with systematic maintenance, is imperative if hydraulics is to deliver the service of which it is capable.

Fig. 3. Service on the supply lines of this machine had been a difficult job prior to the "revitalization" changeover.

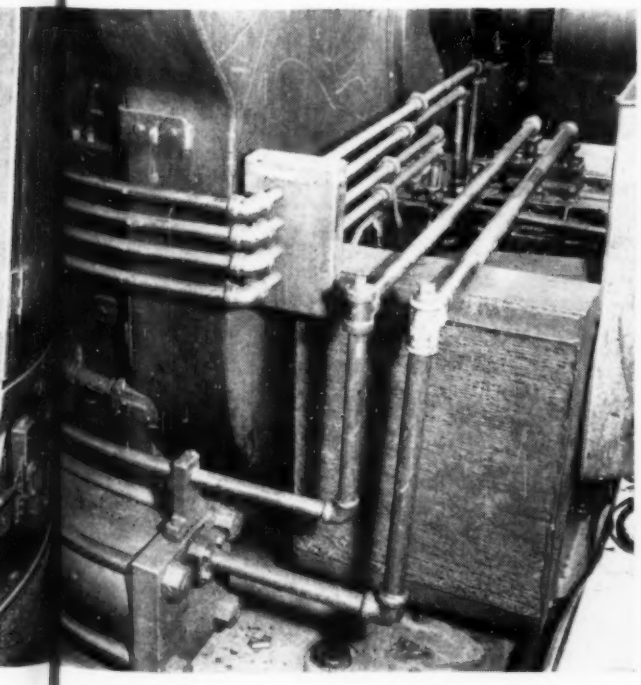
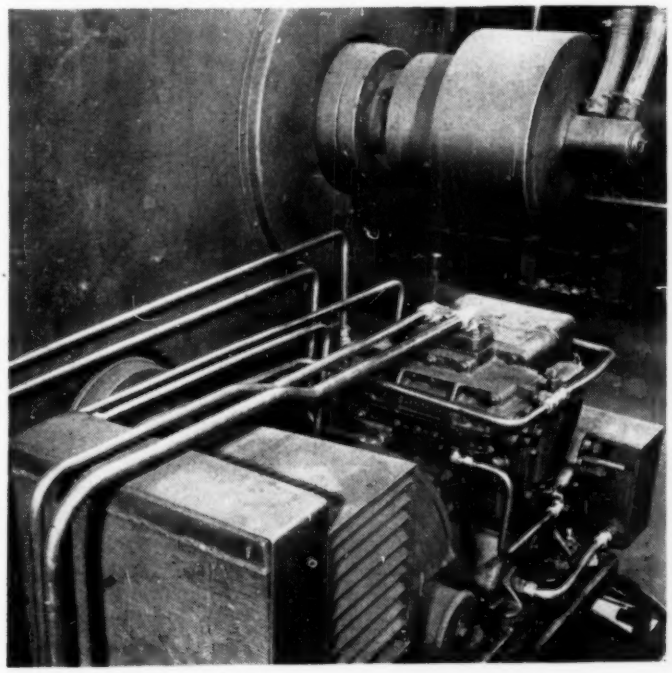


Fig. 4. The same machine shown in Fig. 3 after the streamline tubing installation. Maintenance has been greatly simplified.



An excellent example of how such a program can be accomplished is found in the Chrysler-Jefferson plant. Production of Chrysler and DeSoto engines and marine engines in this plant utilizes a large number of hydraulically operated machine tools.

Back in the summer of 1946, following the aftermath of the war when production officials in this plant had had an opportunity to review their hydraulic experience and crystallize their thinking, they determined to "revitalize" their hydraulic equipment. This called for unit or complete system replacements, if necessary, and a properly organized maintenance program.

A start was made on thirteen machines—which because they were the worst-leakers represented the most expensive hydraulic operations in the plant. With the acceptance of our recommendations we removed the heavy, patchwork piping and conglomeration of miscellaneous types of fittings in these circuits and installed completely new lines.

In addition to attaining the primary goal of leakproof circuits, other noteworthy advantages were gained. By using tubing, more logical layouts of lines for improved accessibility of both the hydraulic system and the machine proper were possible. Tubing bends substituted for elbows, greatly reducing the number of joints. Standardizing on one type of fitting (a flared tube type of fitting was used for its leak-proof performance) simplified fabrication of the lines and made the installation uniform. Replacement of the old, bulky piping with the new "streamlined" free-flow circuits provided conservation of space in many instances. All thirteen machines certainly presented a much neater appearance.

This re-tubing work had to be done over week-ends so that production was not held up. In rebuilding a machine's hydraulic system, only as much old piping was removed as could be replaced during the week-end working hours. Some of the more complicated jobs required three week-end work periods. One of our representatives was on hand each Monday morning to make sure that the remodeled circuits operated satisfactorily under continuous production conditions.

The improvement in the operation of this original group of machines convinced the plant production officials of the wisdom of their revitalization program. Plans were approved to systematically rework all their hydraulic equipment. To date, approximately 125 machines have been so improved. These include various makes of many kinds of machines—grinders, milling machines, drills, automatics, broaches, honing machines, pad mills, crankshaft machines, drill presses, welding equipment and others.

As a continuing maintenance policy, hydraulic systems are checked regularly. Careful examination is given to all units—pumps, valves, controls and any packings as well as associated linkages. Standardization on tubing and tube fittings has streamlined the entire maintenance operation.

Maintenance carts in the Chrysler plant are equipped with a complete set of tube bending and fabricating tools. Similarly, a good range of sizes and shapes of the standardized fittings can be carried in the truck right to the job. This standardization makes it possible to adequately maintain circuits throughout the plant with a relatively small storeroom inventory of tubing and fittings.

The Chrysler hydraulic revitalization program has kept the oil at work in the tight streamlined circuits; accessibility and simplified, systematic maintenance have improved the good housekeeping so important for the best personnel and machine efficiency. Starting by outlawing oil on the floor the program has brought hydraulic service to its peak level.

MAKING A POINT BY PULLING TEETH

(Continued from page 15)

sary toughness to the steel to resist sharp impacts and shocks in service.

Specially designed dies for clamping the upper and lower ends of the bars are used. Both dies are cored for water passages for cooling.

The sequence of operation, as shown on the schematic diagram, is as follows: the operator depresses a foot pedal which brings down the head to a bottom position with the dies in an open position; the diamond shaped bar is placed in the dies and a second foot pedal is depressed. This action energizes intake valves SV2A, and SV8A and exhaust valves SV3E and SV5E, thus admitting air to the upper and lower clamping cylinders and locking the cam-tightened locking bar to hold the upper and lower ends of the bar securely. A third air cylinder, mounted on the lower die and on the opposite side of the clamp bar, acts as a locator when loading the bar.

The cycle then proceeds automatically. First, a timer establishes a "fixture squeeze" interval to allow the clamping pressure on the work to be established. A second timer then controls the duration of the heating time. The head retracts, drawing the bar into two separate pointed pieces. Another timer delays the opening of the dies after the points are drawn while a pressure switch keeps the upper die closed momentarily as the lower die releases its finished piece. As soon as the lower die is clear, the upper die releases its piece, both pieces dropping through the bottom die.

The automatic cycle simplifies the operation and the Kewanee company reports that it has worked out extremely well.

The entire operation takes approximately 8 seconds including loading time. A production rate of 375 operations or 750 points each fifty-minute hour was maintained without difficulty.

THE HYDRAULIC SYSTEMS IN INJECTION MOLDING MACHINES

THERE are now nearly 5000 injection molding machines in operation in this country. At least two-thirds of these machines use vane type pumps and standard valves and accessories in their hydraulic systems. Well over half of this group of machines are Reed-Prentice, Lester or Watson-Stillman 8-ounce machines which have common hydraulic maintenance problems.

At the present time virtually all injection machine maintenance cost centers around the quality and cleanliness of hydraulic oil used. While this may seem excessive to hydraulic men not familiar with shop conditions in the injection industry, it is true that at least 90 percent of all molders' hydraulic troubles can be traced to dirty or poorly chosen oil. For this reason the selection of hydraulic oils and the use of oil filters in injection machine hydraulic circuits will be briefly discussed. Pump and machine manufacturers and suppliers are still in the midst of educating injection molders in the proper use and care of hydraulic systems. It is amazing to machine manufacturers, for example, that the injection molder is often so totally indifferent to the basic care his machine and its circuits must have to operate 24 hours a day, 7 days a week as he expects it to do.

By LARRY HAHN
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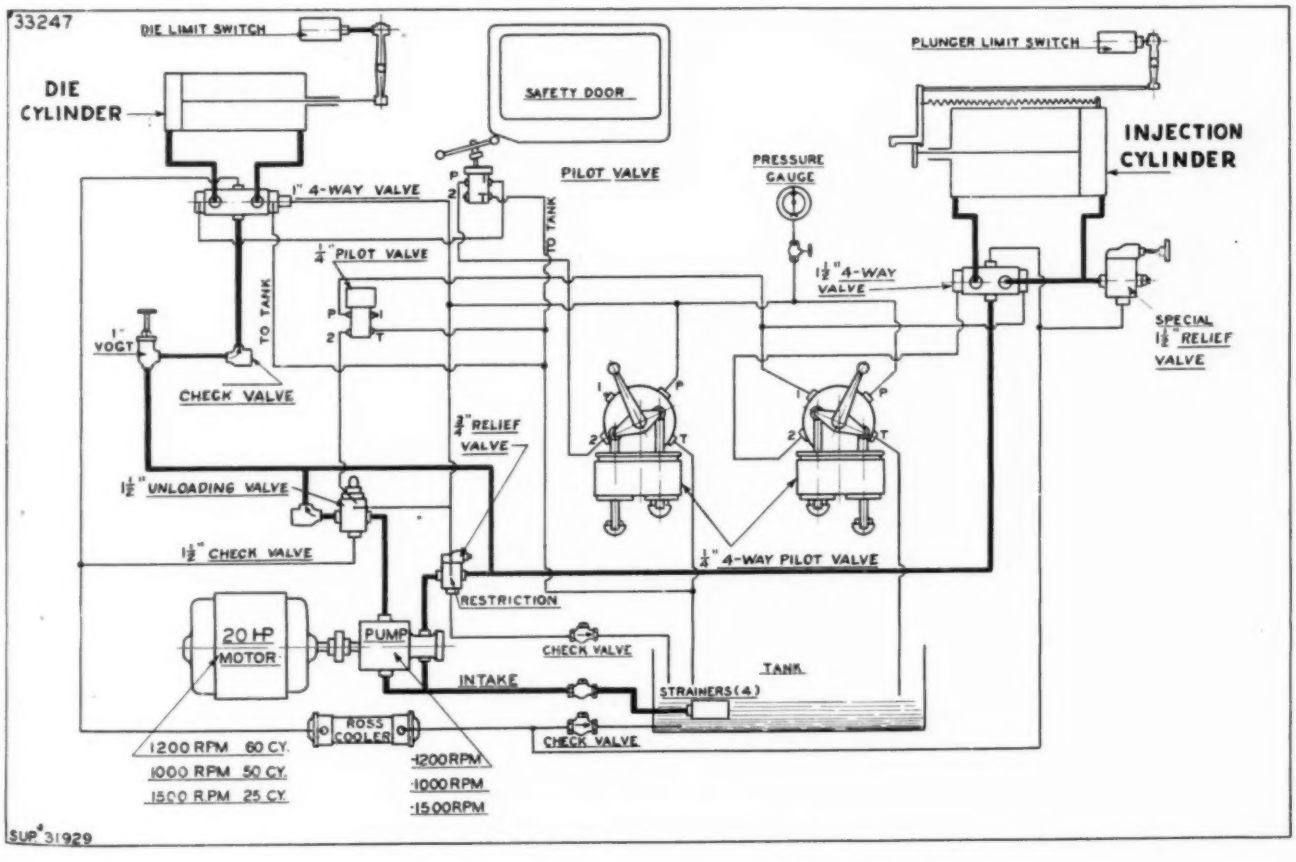
Cleveland, Ohio

There are numerous brands of hydraulic oils on the market and our experience has been that some are definitely better than others. The manufacturers of pumps and injection machines ordinarily do not recommend

Fig. 1. Schematic of hydraulic system in a typical 8-ounce injection molding machine.



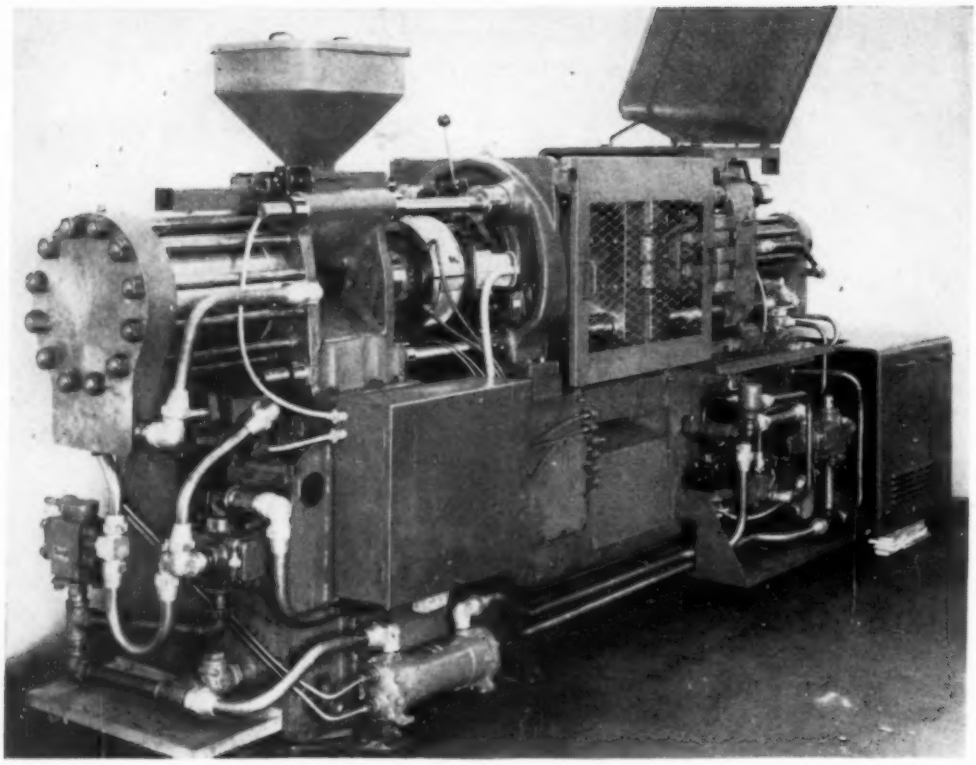


Fig. 2. The Reed-Prentice 10D-8-ounce injection molding machine — rear view with streamline guards removed.

oils by trade names, preferring to give specifications and service properties. This practice sometimes is confusing to inexperienced buyers of hydraulic oils. It is always sound practice to not only buy from an established, reliable supplier, but to work with him in straightening out any difficulties in which an oil may be involved.

New machines seem to run at higher speeds and to prevent a corresponding increase in oil temperatures the use of a slightly heavier oil is coming into more general use.

High Quality Oil Essential

It is very important that a high quality oil be used in the circuits of injection molding machines. There are a number of types of crude oil; various processes of refining add and subtract properties for specific purposes. Inferior oils or improperly selected oils used in continuously operating injection machines may undergo oxidation, become acid or emulsify with moisture from sweaty tanks. Some injection machines, the Reed-Prentice for example, are now equipped with screen or disc type oil filters to remove physical particles from hydraulic systems.

Some of the more progressive molders are installing fuller's earth filters directly in the hydraulic systems. This type of filter is always piped from the return line, usually bleeding from the cooler. These filters use factory-packed throw-away type cartridges. They are easy to service and require attention or cartridge change about twice a year.

The use of this type of filter obviates expensive oil changes and has greatly reduced sticky valves and excessive valve and pump wear. Therefore, the first step in cutting hydraulic oil system maintenance cost is in the selection of the proper oil of the best grade and in the installation of a filter.

During the past year or two a great deal of trouble has been experienced on valve seals. Originally, leather oil seals were used, which wore well. However, a change to a synthetic rubber seal of the same design brought difficulties in leaks, frequent seal changes and oil waste. All this meant the loss of considerable production time. A recent change to an "O" ring type of seal for the stems of pilot valves has eliminated all the previous troubles. An "O" ring type of seal should always be specified.

Another trouble experienced by several molders has been caused by water in the oil. Leaky oil coolers are a frequent offender. This is a serious matter since it means three or even four complete oil changes, and a thorough cleaning of the tank at each oil change to get rid of the fine varnish-like film which adheres to valves and other moving parts in the system.

There is available a solvent type flushing oil which both cuts the film and dissolves small quantities of water, otherwise difficult to remove. Carbon tetrachloride or kerosene have been commonly used for this purpose.

Faulty check valves in the high pressure return lines have also caused some trouble. A clapper may shear off and plug the line. The oil, unable to return to the tank, backs up, raising the pressure and stalling the motor. This usually occurs when the full volume-full pressure is used during the injection cycle, as discussed below. It is always worthwhile to use top quality check valves.

Noisy Pumps

There are a number of causes for pump noise. The most important are:

(1) Restrictions in pump suction lines;
(2) Air leaks into pump intake;
(3) Air bubbles in the oil;
(4) Oil which is cold or too heavy and permits cavitation; and
(5) Defects in pumps.

In replacing the cartridges in vane type pumps, it is always wise to use new head gaskets. The new gaskets may be coated with grease to aid in forming a good seal. The adjustment of the heads of vane type pumps is very critical, and should be undertaken only by an experienced man. The head screws are never fully tightened down; all screws should be drawn up evenly to clamp the pump cartridge without binding and so that the shaft can be easily turned. One loose screw, for example, may cause as much as 200 psi loss in pressure. One tight screw may result in snapping off the pump shaft.

The head gaskets of vane type pumps, as well as the oil seal on the main shaft may take a set with age and constant use (or with accidental over-heating) and may cause leakage of air into the pump. This is easily detected by the resulting noise. Noise or pump rattle may also be caused by leaky intake lines and, as we have noted, by plugged intake screens.

A major advantage of vane type pumps is the ease with which they may be serviced and repaired. This is important to injection molders who must watch maintenance costs and who, in most cases, have few facilities for elaborate hydraulic repairs.

Hammer

Another problem encountered in the field may be hammering in the hydraulic lines due to sudden shifting of pilot operated valves. Hammering was overcome by the use of restrictions in the pilot lines as for example on the Reed-Prentice—a .041 restriction in the pilot line leading to the low pressure relief valve; a .078 restriction in the pilot line leading to the high pressure relief valve; and a .040 restriction in the pilot line leading to the link end four-way valve.

These restrictions had the effect of slowing some machines down. The restrictions can be opened slightly without injurious effect up to the point where hammer again begins. However, most molders simply screw down on the low pressure relief valve to increase platen speed. This practice is not harmful, provided the low pressure is not run over 450 psi. At or beyond this figure the oil will overheat and the machine is likely to chatter as the platen moves.

The most frequent source of trouble on injection machines is loss of pressure due to marks or scoring on the seats and balls used in high pressure relief valves. In recent months a cone-point or arrowhead type of stem has been used to replace the balls, but its life is not much better. When pressure is lost, either in the entire circuit or in the injection system alone, the first step is to inspect and replace the ball or cone-point, and, if necessary the seat in high pressure relief valves. In installing either type, a brass rod should be used to firmly tap them into place. This is the complete operation unless examination discloses that the seat itself requires replacing.

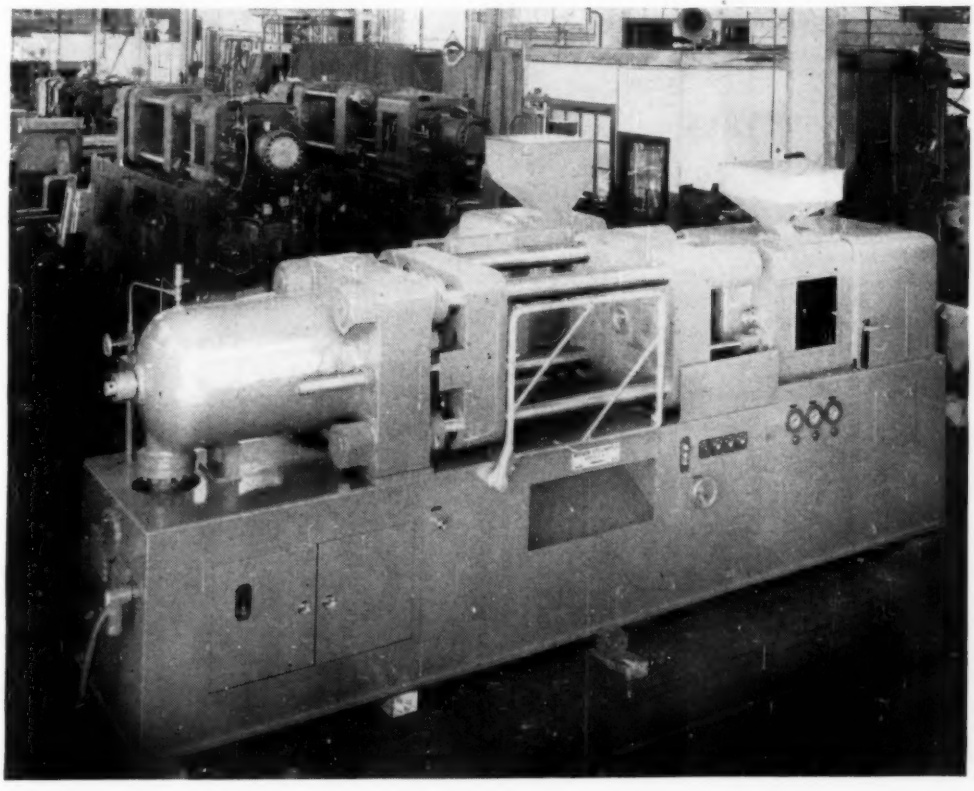


Fig. 3. The standard 8-ounce Watson-Stillman injection molding machine.

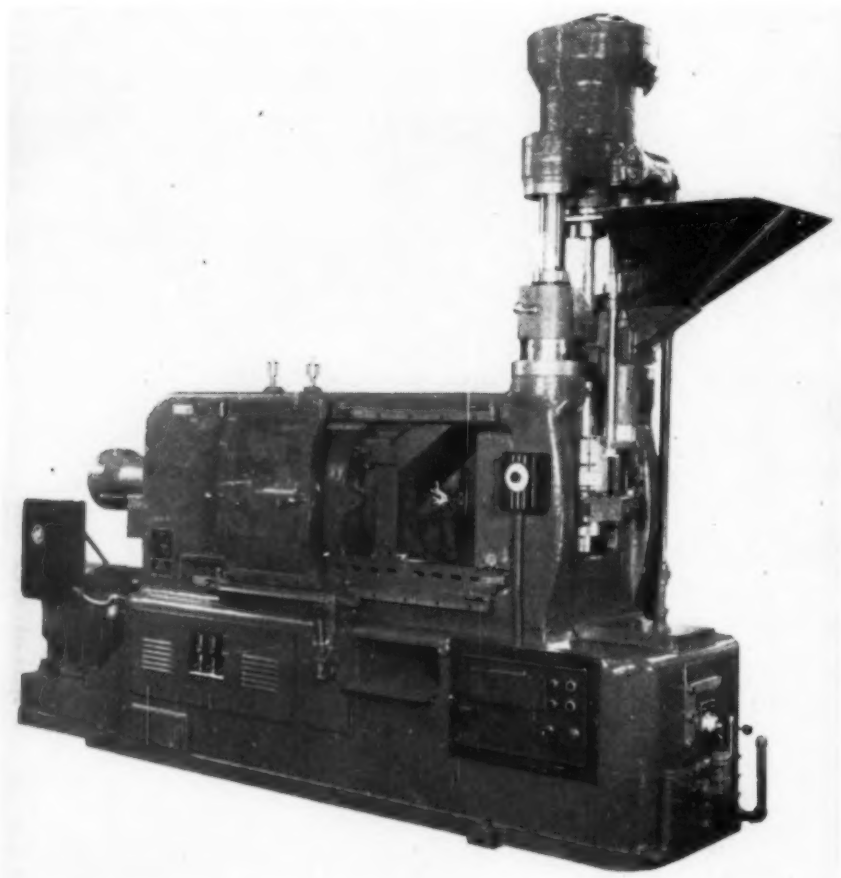
SAVE THIS VALUABLE REFERENCE MATERIAL! BUILD UP A PERMANENT FILE

The Booster Function

Most injection machine hydraulic systems differ from conventional systems by using a "booster" which acts to hold out the low pressure relief valve during the injection cycle for a set number of seconds to permit the plunger to attain maximum speed and pressure to completely fill the mold. The system is hydraulically foolproof; most of the trouble met with has been in the limit switches used to start the booster timer and in the interval timer itself. This timer, incidentally, is a critical process control factor. Without the booster the injection machine plunger moves slowly and erratically as the plunger meets resistance in filling the mold with hot plastic, then moves, then slows down again. Flow marks in molded parts are the result of this erratic action. The booster, by momentarily cutting out the low pressure relief system gives the injection cylinder full volume and at the same time allows the molder to regulate the pressure of injection. The booster timer, usually a 5-10 second maximum timer, and the injection pressure regulating valve are the molders' most critical process controls because the results of adjustments are immediately observed in the product. Adjustment of the molding heat and the time cycle require at least several minutes before the results of changes are observed in the molded piece.

Some recent models of injection machines incorporate a plunger return feature by which the plunger is brought part way forward while the mold is closed and is still chilling the charge. This saves from 2 to 4 seconds per cycle; but must be foolproof to avoid accidents. With correct setting of the limit switches which stop the plunger in the mid-position, this feature is also hydraulically foolproof. The use of standard pilot and four-way valves in applications of this type has done much to eliminate operating and maintenance problems.

Fig. 4. The Lester Model L-2-½-8 (8-ounce) injection molding machine.



It is poor economy to choke off the water supply to the oil cooler to save water bills. The danger of overheating with its shortening of both machine and pump life is far too great. Very few valves and pumps fail to give at least six or seven years of service under severe round-the-clock operation.

Gasket trouble is encountered but it can be virtually eliminated on injection machines by periodic tightening of all cylinder head bolts with heavy wrenches. Some molders object to small leaks at packing glands—a drop each half dozen strokes—necessary to keep the glands lubricated—and by over-tightening packings take the life out of them prematurely.

More usual problems like leaks or use of dirty or inferior oil are the chief headaches in the field. With clean filtered oil, oil life is long and hydraulic maintenance costs are today practically nil in the injection molding industry.

There are always a few problems that occur sporadically or at long intervals. Only rarely will a defective valve, a weak spring, a porous casting, a sprung shaft, a valve insert out of round, a split check valve seat or a seat which will lift out of place give trouble. However, because the problem is unusual, it may be quite difficult to run down. Systematic checking for the usual difficulties will ordinarily indicate that an unusual trouble has developed. The use of circuit diagrams is always useful in running down both common or seldom encountered troubles.

The injection molder will be able to get the maximum number of production hours of top operation from his machines by observing a few basic rules of maintenance: buy and use the best materials and parts; learn the symptoms of the common troubles and the most direct corrective measures to take; and make full use of the experience and skill of both machine and hydraulic equipment manufacturers.

SAVE THIS VALUABLE REFERENCE MATERIAL; BUILD UP A PERMANENT FILE

(Continued from page 13)

tion, which produces a valve *rate* proportional to the measurement deviation from the control point.

In the following discussion the proportional speed floating action is referred to as reset.

If we combine the proportional and reset functions in a single controller, the valve action for an increasing deviation will be the sum of the proportional valve action and the continuing deviation of reset action. Two distinct reactions are produced by a given measurement change. The *amount* of corrective action due to the proportional action will increase only as the magnitude of deviation increases; the *amount* of corrective action due to reset will increase as the magnitude and *duration* of deviation is increased. In other words, one correction is governed by the magnitude of the deviation, the other primarily by the duration of deviation.

In the proportional and reset controller the measurement is controlled by the valve. The initial movement of the measurement is caused by a sudden and sustained load of considerable magnitude. The valve reacts to restore the measurement to the original control point. The measurement is returned to the control point with a minimum of cycling. The valve, however, assumes a new position. The original motion of the valve responding to the motion of the measurement was due to proportional action; the movement of the valve to its new position was due to reset. Had the controller been a simple proportional type in which the position of the valve is related directly to the position of measurement, the load change would have called for a new valve position, which could have been obtained only with a sustained deviation of the measurement. The system would have been stabilized with both measurement and valve in new positions. On processes in which the measurement must be returned to the control point, the reset function is essential.

Figure 3 illustrates a proportional controller to which reset has been added. The only addition to the system has been the bellows marked "reset bellows", which has been substituted for the proportioning spring, and a capillary resistance tubing between the proportioning and reset bellows.

Proportional and Reset Controller

It is apparent that the pneumatic follow-up system operates exactly as in the proportioning controller, i.e., a change in element position results in a change in output pressure sufficient to move the proportional bellows the exact amount necessary to compensate for the movement of the element. The reset bellows, for any given air pressure, functions in the same manner as a spring. However, if the pressure in the bellows changes, the arc lever will be moved in the same manner as if the proportioning bellows pressure had changed. However, the movement will be in the opposite direction.

For convenience in following the circuit through the cycle of operation, let us assume a pressure of 8 lbs in the two bellows units, the measuring element in position to hold the flapper tangential to the nozzle. In this position the unit may be said to be in equilibrium. The measuring element is manually moved in a clockwise direction an amount to produce a 2 lb change in the proportioning bellows. The flapper moves away from the nozzle reducing the pressure in the proportional bellows to maintain the original flapper-nozzle relationship. If the measuring element is held at that point the system would momentarily come to equilibrium with the proportional bellows at 6 lbs and the reset bellows at 8 lbs.

However, since there is a resistance in between the reset and proportional bellows, air will start to bleed from the higher to the lower pressure in a direction to equalize the two pressures. As soon as the pressure in the reset bellows drops, tending to move the arc lever downward, the flapper starts to move away from the nozzle, reducing the pressure in the proportional bellows, acting to maintain the 2 lb differential. As long as the measuring element is not moved the air from the reset bellows will continue to flow through the resistance toward the lower pressure and the relay will continue to operate to maintain the 2 lb differential. When the pressure in the reset bellows reaches 2 lbs, that in the proportional bellows reaches 0 lb at which point the controller has reached the limit of its proportional band.

If during this resetting process the measuring element is manually restored to its original position, the relay will adjust the pressure in the proportional bellows until the arc lever is back in its original position. If this restoration is at a point at which the reset bellows has reached 6 lbs, the proportional bellows would have a pressure of 4 lbs. The relay would restore the pressure of 6 lbs to the latter bellows, restoring the pressure of the output to its original setting.

The rate at which the resetting function takes place can be varied by varying the amount of resistance between the two bellows; the greater the resistance the longer it will take for a certain pressure change to be obtained. The reset time of this type controller can be adjusted to suit a wide range of process reaction time.

We have touched on the fundamentals of design and operation of three of the common types of pneumatic controllers. A clear conception of what they are and what can be done with them is a very useful tool for the engineer and designer who, with increasing frequency, must face and solve the perplexing problems of control.

SAVE THIS VALUABLE REFERENCE MATERIAL: BUILD UP A PERMANENT FILE

Applied HYDRAULICS DIGEST

Abstracts, summaries and listing of articles on hydraulic and associated applications in industry; reports on prepared papers, talks and discussions of special interest to the hydraulics field.

Designing for Economical Manufacture

Benjamin N. Ashton, *Machine Design,* v 20, February 1948, pp 101-106.

The importance of a designer's knowledge of general manufacturing processes and of the detailed capabilities of the machinery in his plant is illustrated by case histories in the design and building of hydraulic elements in the author's plant. One example, given in some detail is that of the design and building of a series of cylinders which were evolved from a much more complex series manufactured during the war. In one instance cost was cut to approximately one-sixth, the entire reduction being due to design changes. The new cylinders are lighter and simpler yet do the same job. No special effort was made to reduce the number of parts—in fact, in some cases two or more simple parts replaced a single complex piece. Simplified design did, however, greatly reduce the number of operations required for fabricating. The number of operations required to produce the parts of this series of cylinders was reduced from 45 to 21.

The manufacturing advantages of simplified design were not limited to cylinders. One old style valve required 65 operations and only two parts were partially made on automatics. Its successor, a new style of a competitive model required only 54 operations and all eight parts are made almost entirely on automatics.

The same principles are applied to new designs. An oleo landing gear for personal aircraft was designed as nearly as possible for universal application. Main gear models were designed for use on tricycle or conventional landing gear for both fixed or retractable installations on amphibians and helicopters. Nose wheel gears were designed for either steerable or free-castering installations. Many of the major components could be made common to virtually all installations. Major parts could be made standard for several different installations so that virtually all components could be used on a multiple of installations. Simplified design permitted machining to be confined to either the inside or outside of parts. The entire operation illustrates the advantages which close coordination between design engineering and process engineering can give to a line of manufactured products, the simplicity of design and the fullest utilization of automatic equipment being coordinated to reduce manufacturing costs.

Give Control Valve a Chance

C. B. Nolte, *Oil and Gas Journal,* v 46, November 29, 1948, pp 65-69, 78, 79.

A review of the major considerations in the selection of control valves. A method for determining pressure drop to be used in selecting valve size is included. Methods of by-passing the control valve and valve loading are also briefly treated.

Air Devices

P. H. Winter, *Electrical Manufacturing,* v 39, July 1947, pp 74-77, 152, 154, 156, 158, 160, 162, 164.

A survey of both manual and automatically actuated pneumatic controls tied electrically into the cycling of automatic machines through limit switches, solenoid valve or mechanically through cams. Applications cited are chiefly for machine tools and special purpose metal working machines.

A Tractor Torque Converter

C. E. Frudden. Address before the American Society of Agricultural Engineers, University of California, Davis, California, February 13, 1948.

An exceptionally lucid explanation of the design and operation of the three stage torque converter used on the Allis-Chalmers HD-19 diesel, the largest and most powerful crawler tractor. Mr. Frudden traces the early development of the torque converter through the wartime applications to high speed prime mover tractors for hauling heavy artillery.

In the three stage converter the pump runner driven by the engine is nested inside the turbine wheel, eliminating the need for a pump casing. The three stages or sets of blades are combined in a single wheel. The fluid strikes one set of blades after another. Two sets of fixed reaction blades are mounted, one set between the first and second and the other between the second and third sets of turbine blades to change direction of the fluid flow, the reacting force multiplying the torque. Since the engine runs at approximately constant speed, the same horse-

power and volume of fluid is delivered to the turbine blades independently of the speed of the turbine and of the tractor. The engine is never overloaded and pulled down in speed—it cannot be stalled. The tractor speed is automatically regulated by the drawbar pull, although the speed may be also controlled by manual operation of the engine throttle. The disadvantages as well as the advantages of the torque converter are pointed out. Mr. Frudden concludes that the increased amount of work accomplished per day of operation with less operator effort and with decreased wear and tear on transmission parts are advantages that more than offset a higher first cost and greater fuel consumption.

Servo Control for Steering Engines

C. L. **Eigelbach,** *The Nautical Gazette,* v 141, July 1947, pp 24-26.

A picture story of an electrical control (selsyn-amplidyne) for electro-hydraulic steering extending from steering wheel to main hydraulic pump. Equipment required for both ac and dc power supply are given.

Possibilities of Small Hydro Plants

P. H. **Beauvais,** *Industry and Power,* v 54, February 1948, pp 78, 79, 108.

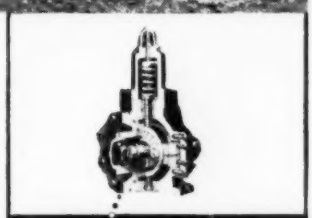
The municipality of Allegan, Michigan, has installed a small hydro-electric plant on the Kalamazoo River consisting of three units, including turbines and generators with necessary auxiliary controls, delivering 450, 900 and 1200 kw. Turbines are regulated by oil pressure governors which have proven satisfactory both in regulating and balancing the parallel operation. A separate motor driven gear pump maintains about 200 psi on an air cushioned oil reservoir. A pilot, controlled by the governor, admits oil from the reservoir to a double acting piston capable of exerting a 21,500 in lb torque on the wicket gate operating ring. Loss of oil pressure below a predetermined point causes a release to trip, closing the gates; the unit is shut down automatically since the gates shut tightly enough to bring the turbine rotor to a standstill. Starting is accomplished by setting the governor pilot manually and then bringing the unit into synchronization through the speed regulator on the switchboard. A small air compressor is used to blow off dirt and to replenish the air over the governor oil reservoir.

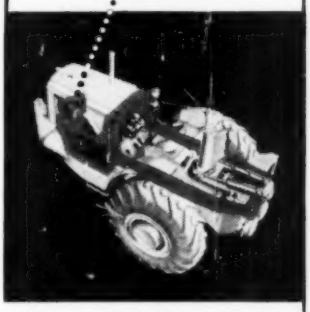
Applications of Air Cylinders

J. E. **Hyler,** *Veneers and Plywood,* v 41, May 1947, pp 22, 24.

Case histories of applications of air cylinders to various types of woodworking machines. The author states that most woodworking plants are equipped with adequate central station air available for operation of air cylinders.

POWER PLUS
for Hydraulic Steering





THE HEIL COMPANY'S big, heavy duty Heiliner, 2-wheel, high speed tractor shown above, utilizes hydraulic steering. The complete unit, consisting of tractor and scraper, when loaded weighs 45 tons. The power is supplied by a Variable Volume Special RACINE Pump, modified to provide easy handling of this giant earth mover. Note photo to right—pump is engine driven.

Variable Volume RACINE Pumps provide a source of hydraulic force with these advantages—simplified circuits—reduced number of needed valves—lower horsepower consumption. On many installations, smaller oil reservoirs may be used because heating is reduced.

Trained hydraulic engineers and a well qualified staff of special field representatives offer you a complete consulting service without cost or obligation. Write today for our catalog P-10-C, illustrating RACINE's full line of Variable Volume Pumps, Sleeve Type Valves and Pressure Boosters. Address RACINE TOOL AND MACHINE CO., 1774 State St., Racine, Wisconsin.

RACINE *Hydraulic* FOUR-WAY VALVES

A complete line of sleeve-type, balanced-piston four-way oil hydraulic valves in ⅜" to 1½" I.P.S. are available for your hydraulic circuits. Models can be supplied for either manual, electrical or mechanical control.

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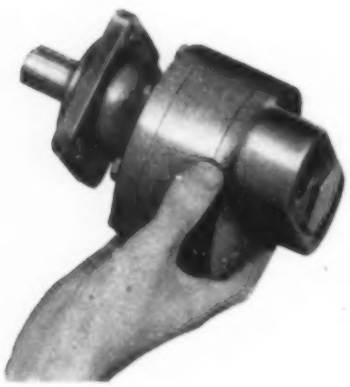
New PRODUCTS

For additional information on any of these products, mark the end key numbers on the card bound in this issue and mail the card.

Low Cost, Constant Volume Pump

The Hydraulic Division of Sunstrand Machine Tool Co. has added to its line of hydraulic



equipment a new low cost constant volume pump for 1000 psi service. This pump is ideal for installations requiring a quiet, efficient, low cost unit. This Model 5W Pump is made in 8 different capacities ranging from 3 to 10 gpm at 1200 rpm. Model 5W Pump is suitable for direct coupling drive only. Use Business Reply Card, mark NP-46.

Hydraulic Pumping Unit

A motor driven hydraulic pump assembly is being offered by the John Dusenbery Co. This Model A power package is designed for automotive and tractor applications requiring large actuating forces, and where the cylinder will retract under gravity or spring load.

The assembly includes a gear pump, an hydraulic ram of 8 in stroke, a 6 volt dc motor, a 5 pint aluminum reservoir and all required valves and controls. Operating pressure at maximum is 1000 psi and capacity is 0.815 gpm. A 115 volt motor is available for industrial plant applications. Use the Business Reply Card, mark NP-47.

Open Blade Gang Limit Switch

The Acro Electric Co. announces a new 12 Gang Open Blade Switch.

The Gang Limit Switch is well adapted for enclosed installation in automatic, electrically actuated control systems, and is available with open, closed or double throw circuit on any pole or combination of poles. The switch is rated at 10 amps, 125 volts ac and requires an operating force of 4½ to 6 oz. Use the Business Reply Card, mark NP-48.

Solenoid Valve

A new solenoid valve has been perfected by Waterman Engineering Company. This inexpensive, compactly-built unit can be used for all hydraulic systems, or for handling non-corrosive fluids. It has a maximum working pressure of 3000 psi, and can be obtained for from 6 to 36 volt dc service.

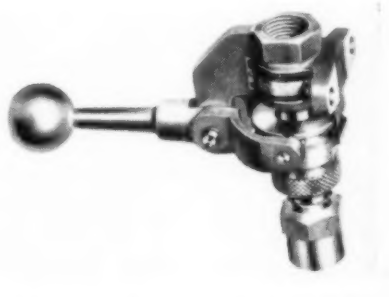
Normally closed models with ⅛ in and ⅜ in ports are standard. Similar models with valve normally open are also available. Use Business Reply Card, mark NP-49.

Special Process Valves

The Parker Appliance Co. offers a line of non-lubricated selector and shut-off valves especially adapted to process control service. The shut-off valves are suitable for pressures to 500 psi and range in size from ½ to 2 in pipe size. The variety of selector valves is wide and permits inter-connection of as many as five separate lines at non-shock pressures to 50 psi. For higher pressures a variation of this valve is available. Sizes range from ½ to 1¼ in. All valves can be furnished for hand or electric motor operation. Use Business Reply Card, mark NP-50.

Low Cost, 3-Way Air Valve

The C. B. Hunt & Son, Inc., manufacturers of air and hydraulic valves, has just introduced a new 3-way hand operated air valve designated 1291-N3.



These valves are designed for use with single acting air cylinders due to their ability to hold positions. They are recommended for use with hoists or other applications requiring the holding of loads in intermediate positions. Furnished in ⅜ and ½ in pipe sizes for air pressures up to 250 psi. Use the Business Reply Card, mark NP-51.

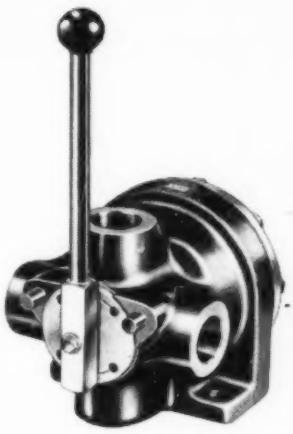
Time Delay Relay

A newly designed air controlled time delay relay is available from American Gas Accumulator Co. Designed for remote actuation the relay is rated at 5 amp on 220 volt ac. It is available in double-throw for single or double-pole, and single or double-break action. The delay interval is adjustable from a

fraction of a second to 15 minutes. Use Business Reply Card, mark NP-52.

Heavy-Duty Selector Valve

Saval Company announces a new 4-way selector valve, No. 8298, for use on 1½ in hydraulic



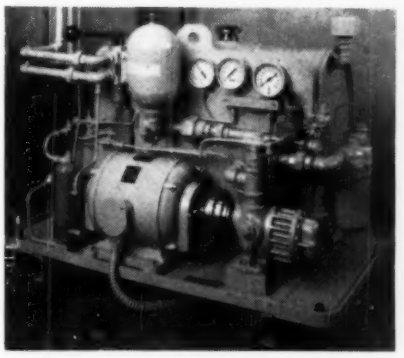
lines. This heavy-duty valve, designed for 5000 psi service, requires only 35 lb force on the 12 in handle to actuate the valve. Designed for corrosion-resistant service with oil, water and gas, the valve provides a metal-to-metal seal that is self aligning and automatically compensates for wear. Use the Business Reply Card, mark NP-53.

Sensitive Pressure Switch

Two pressure switches, of similar functional design, have been added to the line of sensitive units produced by The United States Gauge Div., American Machine and Metals, Inc. The switching differential is but 3 percent of full scale and the electrical capacity is 10 amp at 125 volts ac. This differential is available from 30 in vacuum to 10,000 lb pressure. Both switches, types V and VI, are available in a wide range of sizes and pressures for pressure and temperature measurements. Use Business Reply Card, mark NP-54.

Fluid Power Package

The SECO Fluid Power Package produced by the Simplex Engineering Company contains all the essential components for automatic high-low hydraulic press operation. This power package is built around the SECO radial high pressure



pump designed for pressures up to 10,000 psi. A single control lever governs both circuits. Use the Business Reply Card, mark NP-55.

Highly Sensitive Relays

Relays 275 and 276, developed by the Western Electric Co., give high speed, dependable switching under adverse atmospheric conditions. Mercury-wetted contact surfaces give

In applied hydraulics

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Built with lathe turned bourdon tube and precision, heavy-duty movement, the Marsh Hydraulic Gauge represents Marsh accuracy and stamina in its highest development. The standard dial is graduated in pounds per square inch, but special dials are available to indicate tons or pounds on rams, pistons, or converters; atmospheres; or double scales showing pounds per square inch and corresponding ram pressure. Gauges are available in a wide range of case styles, dial sizes, and pressure ranges up to 30,000 lbs.

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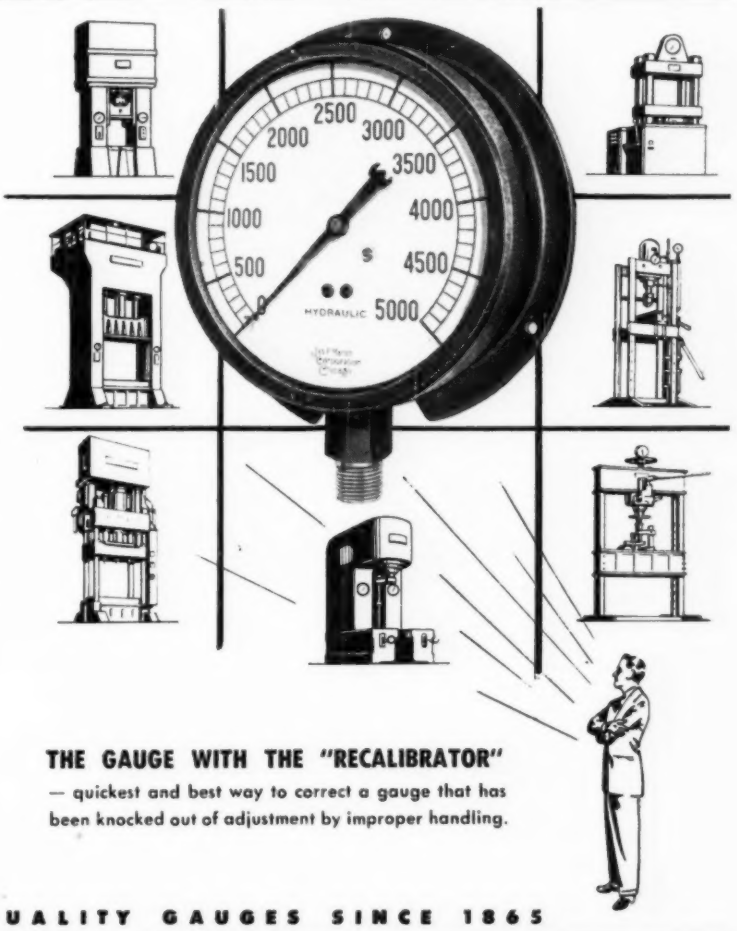

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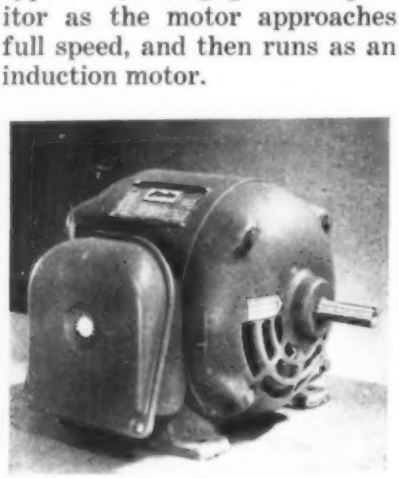
almost instantaneous break of contacts with high current handling capacities. These relays are suitable for use with servomechanisms. Use the Business Reply Card, mark NP-56.

Single-Phase Squirrel Cage Motor

A single-phase, capacitor started, induction run motor is available from Westinghouse Electric Corporation in ratings from ¾ to 7½ hp. This newly designed squirrel cage motor, type CAP, disengages the capacitor as the motor approaches full speed, and then runs as an induction motor.



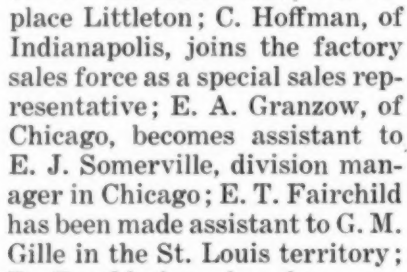
The type CAP motor can be used for practically any single-phase application including: compressors, reciprocating and centrifugal pumps, machine tools, etc. Use the Business Reply Card, mark NP-57.

Directional Control Air Valve

Fast-acting push button control for small air operated presses and similar units is now available in an electrically operated 4-way valve produced by Hannifin Corp. The valve is a packless, reciprocating disk type, pilot operated and solenoid controlled. Two types—double solenoid or power-offset operation — are available in three models, ⅜ to ¾ in inlet and ½ to 1 in exhaust. Air pressures to 150 psi can be handled. Use Business Reply Card, mark NP-58.

Pressure Booster

Five ratio sizes ranging from 3:1 to 7:1 are available in The Racine Tool and Machine Company line of hydraulic pressure boosters. These standard units will produce pressures as high as 3000 psi. No special mountings are required. The maximum range of booster work is developed when used in conjunction with a variable volume pump. Use the Business Reply Card, mark NP-59.



POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

R. W. Morrison, manager of the Air Tool Division, The Aro Equipment Corporation, Bryan, Ohio announces the following changes to the field sales personnel: J. W. Littleton, division manager in Cincinnati, takes charge as manager of the Detroit territory; L. O. Barrett, of the Cleveland office, will replace Littleton; C. Hoffman, of Indianapolis, joins the factory sales force as a special sales representative; E. A. Granzow, of Chicago, becomes assistant to E. J. Somerville, division manager in Chicago; E. T. Fairchild has been made assistant to G. M. Gille in the St. Louis territory; B. Broekhuizen has been appointed representative in the Atlanta territory under J. McEwen Cherry, territory manager; H. J. Connell has been made assistant to A. B. Schuhl, manager of the New York office; and W. Y. Smith becomes assistant to T. F. O'Malley, New England manager in the Boston office.

Hanna Engineering Works, Chicago announces the opening of a direct factory office in Detroit. Frank A. James, formerly with Vickers Inc. and W. J. Renaud, formerly with Charron Engineering Sales, have been appointed to serve in this new office. At the same time John Furey was appointed district representative for the New England States with an office in Wethersfield, Conn., and The Scott Equipment and Engineering Co., Dayton has been named to represent Hanna Engineering Works in Southern Ohio.

The John S. Barnes Corp., Rockford, Ill. has named the H. E. Stone Supply Co., Oaklyn, N. J. as Middle Atlantic States representative.

Four-Way Air Valve

Lindberg Engineering Co. announces a new line of hand operated air valves, utilizing the balanced piston principle. The 3-position, 4-way valve is designed for 175 lb maximum working pressure. The lever

positions of forward, neutral and reverse permit easy cylinder control and make it possible to stop at any position. Use the Business Reply Card, NP-61.

A. R. Lundbeck Co., Minneapolis has been appointed distributor of motor and other controls by Allen-Bradley Co., Milwaukee. Lundbeck's area will include Minnesota, Western Wisconsin, North and South Dakota.

The St. Louis Chapter, American Society of Lubricating Engineers at their February 17th meeting heard Frank Ross, national lubrication manager, E. F. Houghton & Co., on "Confused Lubrication". This talk has been presented to a number of ASLE chapters during the last year. Ross will speak at the San Francisco Chapter on April 8th.

A new entry into the flexible tubing field has been announced. The Flexible Tubing Corporation, organized late in 1947, will center its laboratory, design engineering and manufacturing facilities in Branford, Conn. Frederick K. Daggett, former sales and engineering manager of the Spiratube Division of the Warner Brothers Company, is president and treasurer; Joseph B. Morse, New Haven attorney, is secretary; Alexander K. Murphy is assistant treasurer. Over two years of experimental and field work has been done in arriving at design and construction features of the new line. A wide range of sizes for air, oil, gas and powdered and granular light solids have been announced.

Union Mfg. Co., New Britain, Conn., has purchased the air chuck and air chuck cylinder business of Hannifin Corporation, Chicago.

American Relay & Controls Inc., Chicago, manufacturer of electrical relays, switches and specialized controls has been purchased by David T. Siegel, manufacturer. The firm has moved to 4900 W. Flournoy St.

The annual Westinghouse Machine Tool Forum will be held in Hotel Statler, Buffalo, N. Y., April 22-23.

Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

49. Hydraulic Cylinders . . . A 16-page bulletin published by Anker-Holth Manufacturing Co. describes their line of non-rotating hydraulic cylinders for pressures up to 1000 psi. Complete specifications and drawings on cylinders from 1½ to 8 in diam bore in seven types of mountings are presented. The cylinders are made for working pressures up to 2000 psi. Cylinders of the same sizes with 2 to 1 differential piston rod are presented in a separate section. The last page contains a cylinder capacity chart.

50. Precision Switches . . . This catalog, issued by Micro Switch, Division of First Industrial Corporation, deals with precision snap-action electric switches designed for control of alternating current circuits in industrial applications. Catalog No. 61 is divided into 8 sections describing the basic, high sensitivity, limit and other type switches. A final section is devoted to general technical data.

51. Pump Catalog . . . The Tuthill Pump Company has issued a general catalog on hydraulic pumps and motor driven units. Of special interest are the viscous liquid, coolant and high pressure pumps. The viscous pumps are offered in two models; one is not to exceed 100 psi, the other is not to exceed 400 psi. The high pressure pumps have capacities from 1 to 200 gpm for working pressures to 400 psi. A special section describes stripped pumps for design or replacement work.

52. Broaching Machines . . . The Oilgear Company has published a new 12-page bulletin No. 22001, covering their new Vertical Cyclematic Broaching Machines. It illustrates close-up views of typical cycle sequences. Also shown are detail drawings of work parts with production data and machine setups. A table of specifications covers machines of 15, 25 and 37 ½-ton pulling capacity with 54 and 66 in stroke. Accessories and machine components are reviewed separately and illustrations of other types of broaching machines in the Oilgear line are included.

53. Temperature and Pressure Controls . . . The C. J. Tagliabue Division, Portable Products Corporation describes, in catalog No. 900E their line of non-indicating temperature and pressure controls. The complete line of air operated controls include pressure and time cycle controllers and diaphragm valves.

54. Hydraulic Equipment Catalog . . . The John S. Barnes Corporation include in their general catalog a review of their complete hydraulic equipment line. The general is a loose leaf collection of separate catalogs on the several series of pumps, valves, cylinders, power units and custom built machines.

55. Valve Bulletin . . . Hydraulic 4-way valves for 200 psi duty are described in The Denison Engineering Company's bulletin VD-2. The valves are for ¾ in connections, have sliding spool action, and are available in manual, pilot or solenoid operated types. Brief mention is made of this company's line of pumping units, fluid motors and 4-way valves for 3500 psi duty.

56. Flexible Tubing . . . The General catalog No. G-100 covers

the products of the American Metal Hose Branch, The American Brass Company. This catalog covers hose and tubing for both hydraulic and pneumatic use; seamless tubing, couplings, accessories for many industrial uses. One section is devoted to a pictorial review of applications in many industries. A final section on engineering of hose, tubing and couplings has been assembled especially for the design and layout engineer.

57. Automatic Valves... Pressure reducing and regulating valves built by the A. W. Cash Valve Manufacturing Corporation are reviewed in their general catalog No. D-12B. High pressure valves in sizes 3/8, 1/2 and 3/4 in for work to 2000 psi are shown. Strainers and pressure relief valves are also presented.

58. Fluids and Lubricants... This publication concerns a new class of fluids and lubricants, known as polyalkylene glycols and derivatives, which are completely synthetic organic chemicals. They are produced by the Special Products Division of Carbide and Carbon Chemicals Corporation. Engineers concerned with hydraulics and lubrication control problems should find these lubricants interesting because they contain no wax, remain fluid at low temperatures, and form no sludge. These synthetics were used during the war for aircraft engine lubrication and in brake fluids; are now being used as hydraulic fluids (LB series) lubricants, and plasticizers. Charts and data are included.

59. Cylinder Catalog... Power Plus Products Company in their general catalog show their complete line of hydraulic cylinders and hydraulic power units. The cylinders are available in sizes from 1 to 8 in bore, for 1500 or 3000 psi operation. These nonrotating cylinders are also offered in 3 combination mountings, and with 2 to 1 differential rod. The hydraulic power units are complete and range from 0.53 to 3.6 gpm at from 1000 to 3000 psi.

60. Hydraulic Valves... Bulletin 3-V issued by the Blackhawk Manufacturing Co., presents six types of valves for hydraulic systems. These units ranging from safety valves to manual shut-off valves are designed for operations at pressures up to 10,000 psi. However, they are adaptable to low pressure systems.

61. Couplings and Hose Assemblies... Catalog No. 46, from the Anchor Coupling Co., Inc., shows their complete line of coupled hydraulic hose and assemblies. High pressure hydraulic hose of 3/16 to 1½ in ID for working pressures to 6000 psi are offered in addition to complete assemblies in the same sizes.

62. Switch Catalog... A general catalog on aircraft and industrial pressure operated switches has been prepared by the Meletron Corporation. Switches are available in many models for operations from vacuum to 10,000 psi.

63. Valve Bulletin... This 8-page bulletin No. 235, describes the Hanna Engineering Works line of valves for hydraulic and air control. They include foot operated dual purpose valves in sizes 3/8 to 1 in, hand operated valves in sizes 3/8 to 1¼ in and speed control valves for air working pressures to 250 psi and oil working pressures to 1000 psi. Speed control valves are available in sizes ¼ to 1 in.

64. Oil Filters... A general catalog issued by The Hilliard Corporation contains Bulletin HF on oil filters for continuous operation or batch filtering, Bulletin F-154 on series "C" oil filters and Bulletin R-160 on oil reclaimers.

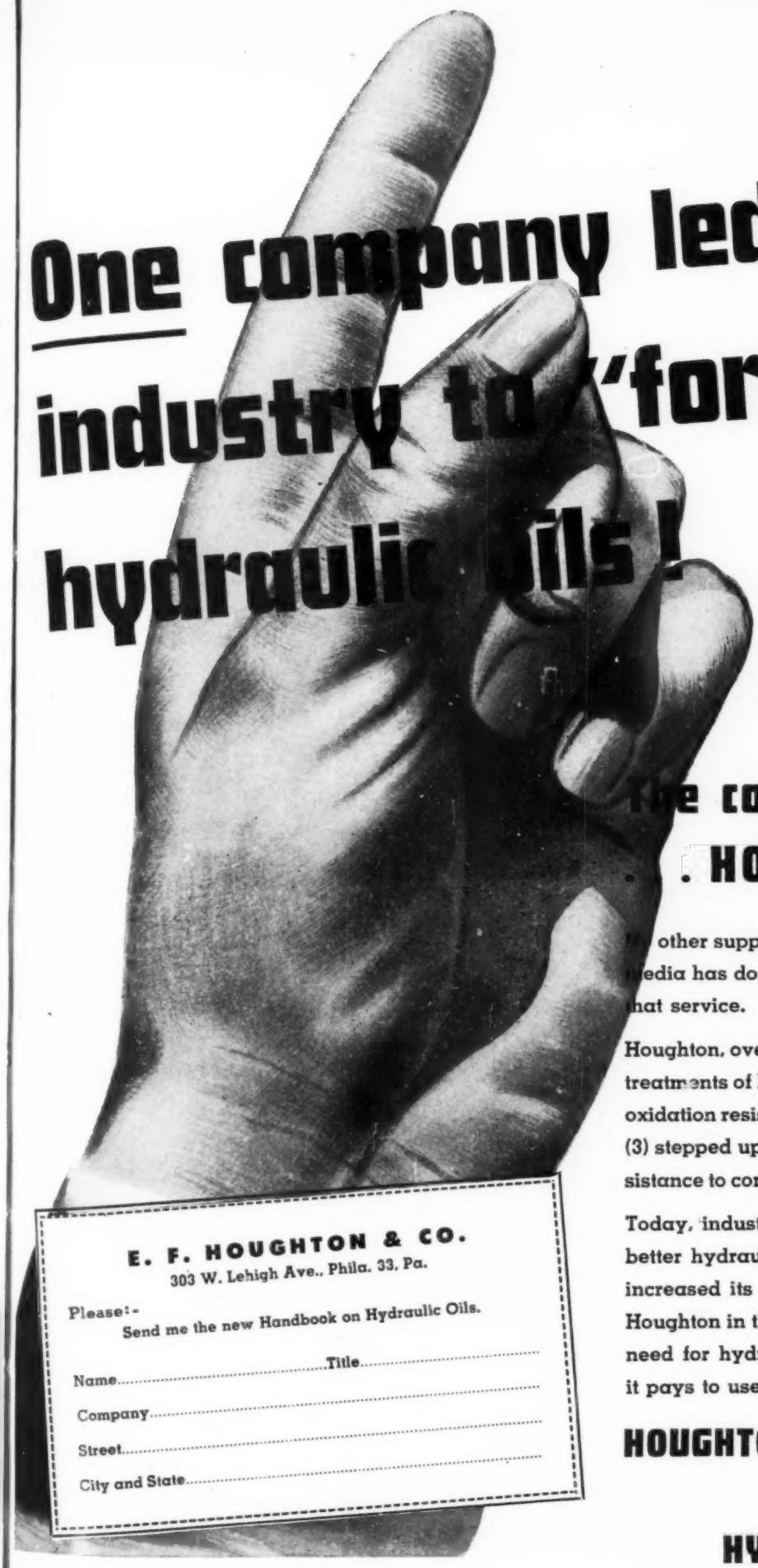
65. Valve and Cylinder Bulletin... The Galland-Henning Mfg. Co. Bulletin No. 92, describes their complete line for hydraulic and pneumatic service. The cylinders, in sizes 1½ to 14 in, are available in four different classes of construction and six standard mountings. They are offered with adjustable or self regulating cushioning and non-cushioning action. Valves shown are for air, oil or water service up to 250 psi, for hydraulic systems up to 1500 psi, and are of the hand, foot or solenoid operated types.

66. Pump Catalog... The line of Hele-Shaw high and low pressure pumps, pumping units, differential valves and hydraulic pipe testing machines are contained in general catalog H of the American Engineering Company. Engineering data and charts are also included.

67. Pumps and Fluid Motors... A 12-page bulletin—Form No. 500—describing the four series of McIntyre precision gear pumps and two series of fluid motors, is available from Eastern Industries, Inc. Series 1200 pump, available in three sizes, delivers from 3.7 to 59.4 gph at speeds from 1000 to 5000 rpm for working pressures to 200 psi. Series 100, operating at drive speeds to 3450 rpm, delivers from 0.1 to 5 gpm at working pressures to 1000 psi. Series 700, also for 1000 psi service, delivers from 0.6 to 9.6 gpm at drive speeds from 200 to 1750 rpm.

68. Automatic Controls... The Mercoid Corporation in catalog No. 600A present their full line of mercury switch equipped controls, of the well-known tilting type and of the light actuated and magnetic types. Of special interest are the hydraulically operated valves and the magnetic valves for pneumatic and hydraulic controls.

69. First Twenty Five Years... A brief history of The Oilgear Company's achievements in peacetime and in wartime is contained in this 30 page brochure. Developments from the first fluid power equipment, up to the present day services and equipment offered by this pioneer company are described.



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PERSONALS

A. M. JOHNSON has been elected chairman of the board of the Barnes Drill Co., Rockford, Ill. W. M. Fairbanks has been elected president and general manager; Reed M. Andress, executive vice president; A. G. Block, vice president, secretary and treasurer; Harold Johnson, vice president and assistant secretary; Roger Marriott, vice president and assistant treasurer.

HOWARD F. MONCRIEFF has been elected president and chief executive officer of the Swan-Finch Oil Corp., New York. Mr. Moncrieff had been vice president in charge of sales.

J. P. CANTOR has been named by Wheelco Instrument Co., Chicago, as district manager of the newly opened Cleveland district office.

HAROLD P. GRANGER has been appointed regional sales manager of the Bellows Company, Akron, Ohio, according to an announcement by H. B. Link, vice president. The Eastern Division with offices in Boston is the first of five new divisions to have a sales manager appointed. Mr. Granger has been with the Bellows Company for three years, and will head the Eastern Division under the supervision of A. S. Terry, general sales manager.

OTTO P. BEREIT has been elected treasurer of The Parker Appliance Co., Cleveland. Previously serving as comptroller he will relieve S. P. Taylor of the duties of treasurer. Mr. Taylor continues as president of of the company.

STEPHEN JOHNSON, JR. has been named chief engineer of the Bendix - Westinghouse Automotive Air Brake Co., Elyria, Ohio.

E. H. HORSTMAN has been appointed chief engineer of the steam turbine department of Allis-Chalmers Mfg. Co., Milwaukee.

RICHARD J. JOYCE of the Link-Belt Co., Chicago, has been appointed to succeed Frank C. Thompson as purchasing agent for the company's Indianapolis plants. At the same time Otto W. Werner was placed in charge of the district sales office at Pittsburgh.

J. JAMES MUDD, formerly assistant sales manager of The Bellows Company, Akron, Ohio has been appointed regional sales manager of this company's Midwest Division. Appointed to this position by A. S. Terry, Bellows general sales manager, Mr. Mudd will head this regional sales division with offices in Chicago. He joined the company after a 12 year association with Delco Remy Corporation.

HANS P. DAHLSTRAND has been appointed director of engineering of the steam turbine department, Allis-Chalmers Mfg. Co., Milwaukee.

WILLIAM TOWNSEND has been appointed general sales manager, Pennsylvania Flexible Metallic Tubing Co., Philadelphia. Edward Sala was named manager of the midwest branch of the company in charge of the Chicago branch office and warehouse.

O. B. WILSON has been named industrial manager for the eastern sales region of the Brown Instrument Division, Minneapolis - Honeywell Regulator Company. The announcement was made by L. M. Morley, vice president of the parent organization and its division. Wilson has been with the Honeywell-Brown organization for the past 25 years as a sales engineer and an industrial manager in various parts of the country. He will make his headquarters in New York City.

EDGAR H. KRAINER has been appointed chief engineer of the U. S. Broach Co., Detroit. Krainer was with the Oilgear Company for over ten years before joining U. S. Broach Co.

ALLEN R. KELSO of the Federal Machine & Welder Co., Warren, Ohio, has been named executive vice president and general manager of the Warco Press & Warren Stamping Divisions. At the same time Walter Dinse was named vice president and general manager of the Welder Division and Harry A. Stix appointed treasurer and comptroller.

C. A. JURGENSON has been appointed acting works manager of the De Laval Steam Turbine Co., Trenton, N. J.

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